PHENOMENA

OF

NATURE.

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NATURAL PHENOMENA, ETC.

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ANNEXED TO EACH PLATE.

PUBLISHED UNDER THE DIRECTION OF THE COMMITTEE OF GENERAL LITERATURE AND EDUCATION,

APPOINTED BY THE SOCIETY FOR PROMOTING CHRISTIAN KNOWLEDGE.

THE RAINBOW.

THE AURORA BOREALIS.

THE GEYSERS; OR, BOILING SPRINGS OF ICELAND.

WATER SPOUTS.

GLACIERS.

ICEBERGS.

CAVERNS.

FINGAL'S CAVE.

THE FALLS OF NIAGARA.

THE PRAIRIE ON FIRE.

HALOS.

CORAL REEFS.

NATURAL BRIDGES.

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SNOW BRIDGES.

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PETRIFYING SPRINGS.

AIR VOLCANOES.

THE DROPPING WELL.

MOUNTAIN PASSES.

PERFORATED ROCKS.

GLACIER TABLES.

THE BREAKING UP OF ICE-FLOES.

THE FATA MORGANA. .

THE IGNIS FATUUS; OR, WILL-O'-THE-WISP.

AVALANCHES.

TORRENTS OF MUD.

WHIRLPOOLS.

SAND STORMS.

VOLCANOES.

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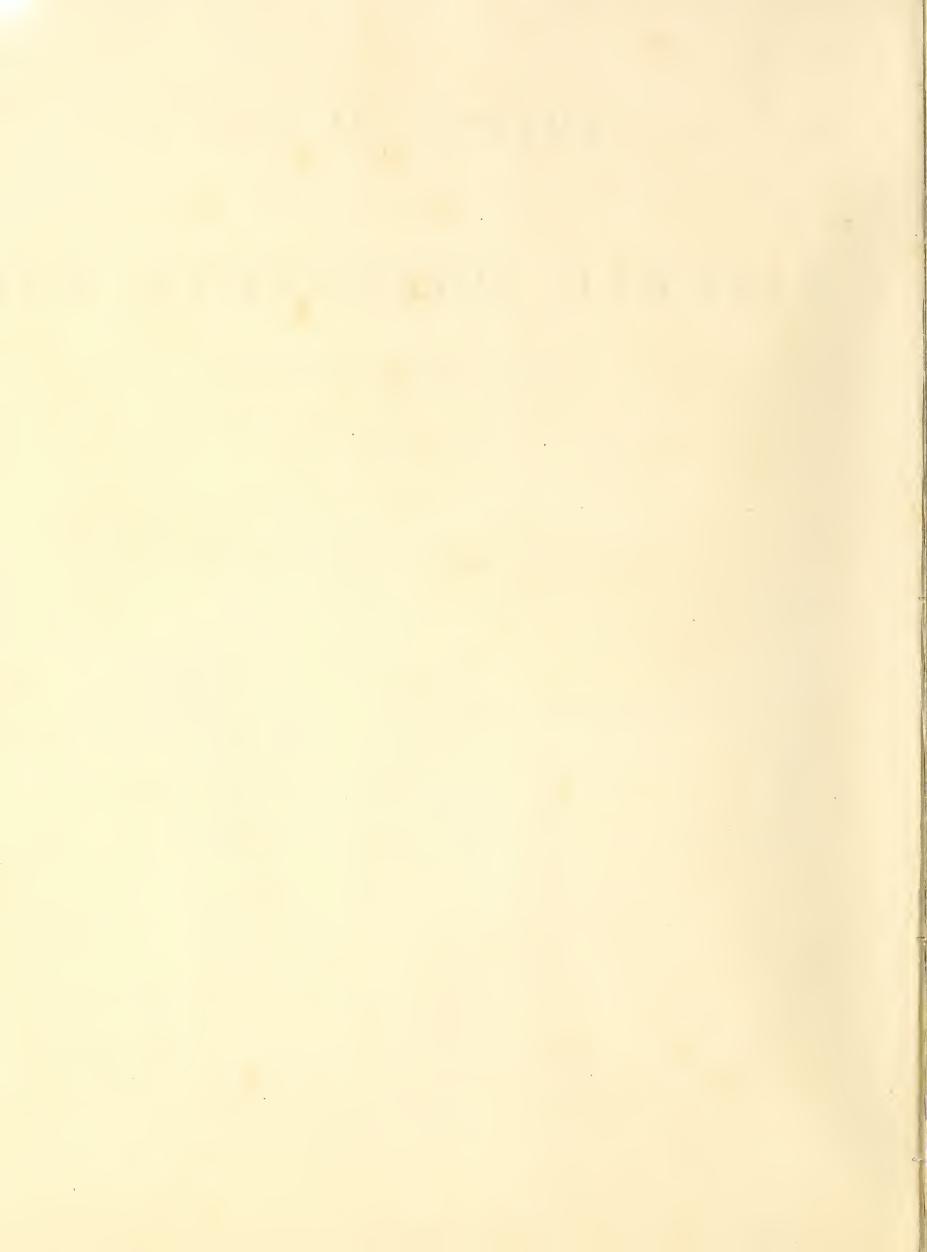
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1846.





THE RAINBOW.

Behold yon bright ethereal Bow,
With evanescent beauties glow;
The spacious arch streams through the sky,
Deck'd with each tint of Nature's dye;
Refracted sunbeams, through the shower,
A humid radiance from it pour;
Whilst colour into colour fades,
With blended lights and softening shades.

THE Rainbow is one of the most beautiful appearances in nature, and is visible when the sun is shining brightly in one part of the heavens, while at the same time a shower is falling in the opposite direction. The observer placing himself with his back to the sun, sees on the rainclouds opposite a majestic arch brightening into the most lovely colours, blended in perfect harmony. While he is yet gazing, if there be much rain, another arch appears, exterior to the first but fainter in colour. Both arches exhibit the same series of colours, namely, red, orange, yellow, green, blue, indigo, and violet; but their arrangement is different, for while in the inner arch the lower edge is violet and the upper red, in the outer arch the lower edge is red and the upper violet.

The cause of this beautiful phenomenon is to be found in the fact, that the light of the sun is made up of three colours, namely, red, yellow, and blue. In passing through the drops of rain, these colours are separated, and bent more or less, from the usual straight direction of the sun's rays. Some of the colours, however, admit of being bent more than others; the blue is bent out of its course more than the yellow,

and this again more than the red, and thus the colours appear separately. These colours, by mingling together, form the other tints of the Rainbow. A similar cause produces the colours of dew-drops, which often appear like differently-coloured gems sparkling among the grass.

When the rain-cloud is of small extent, only a part of the bow is visible: when the clouds overspread a large portion of the sky, a perfect bow appears. Sometimes, indeed, the bow may be traced across a portion of blue sky, or it may apparently rest upon the ground. In the former case, there are vapours in the air of too light a nature to be visible to the naked eye, but sufficient to refract and reflect the rays of light; in the latter, the drops of rain adhering to the grass and foliage produce the same effect. When seen to the greatest perfection, the Rainbow appears as a perfect semicircle, and it cannot exceed this unless the spectator be on elevated ground. In mountainous and stormy regions, rainbows are often seen to great advantage.

Rainbows are sometimes produced by the moon as well as by the sun; but these lunar Rainbows are generally white, cloudy, or greyish, and very seldom exhibit the colours of the solar rainbow. A coloured bow similar to that produced by rain is sometimes seen in the spray of a fountain or of a waterfall, and also in mists that lie low upon the ground.

The beauty of this phenomenon is not the only reason why we should look upon it with great interest. The Rainbow was appointed by God himself as the sign of the covenant of mercy, made with Noah and with all mankind after the Flood. The words in which this declaration was made to mankind are recorded in the Book of Genesis, chapter ix. v. 11 to 16.

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THE AURORA BOREALIS.

"The heavens declare the glory of God" (Ps. xix. 1); yet the more familiar appearances of the sky, beautiful as they are, scarcely awaken our attention, or lead our thoughts towards their Great Author. But when such a spectacle as that presented by the Aurora Borealis first breaks upon the sight, the most indifferent person must be led to reflect upon the worder weeking power of the Divine Hand.

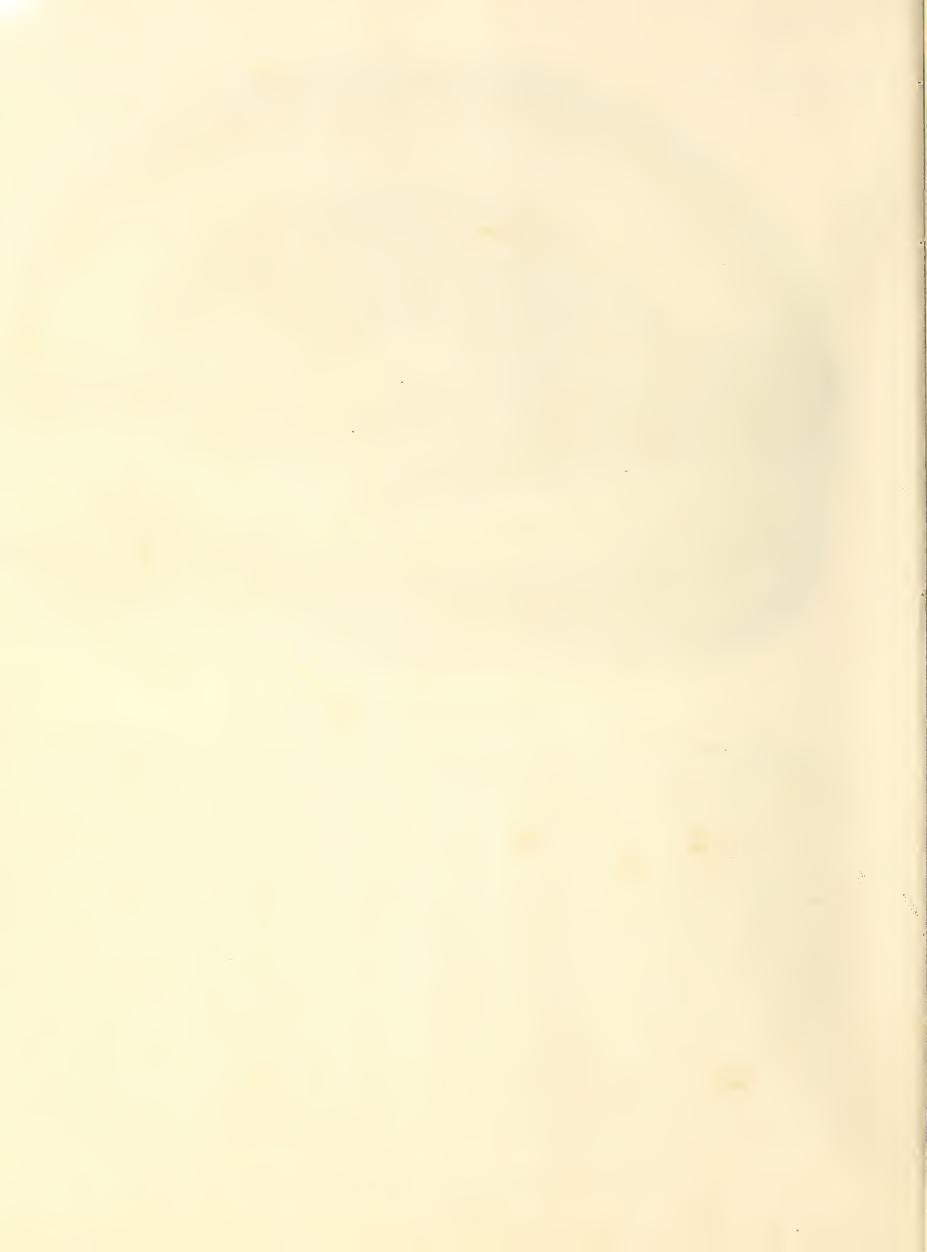
upon the wonder-working power of the Divine Hand.

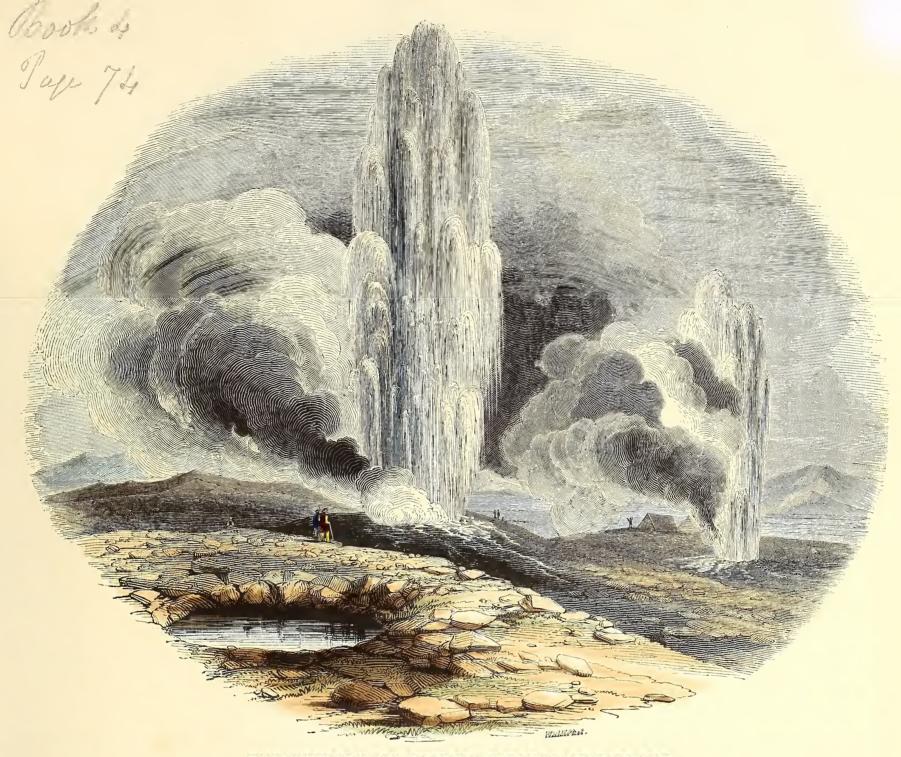
The name given to this phenomenon signifies Northern Daybreak, and is very appropriate, because the Aurora usually appears in the north, and gives a light not unlike that of the dawn of day. It is sometimes seen in this country; but it is seldom brighter here than the light of a subdued twilight. In the regions of the north, and also at rare intervals in this country, it assumes a much more magnificent appearance, and presents a variety of majestic forms. Sometimes, from a focus of light there proceeds a multitude of bright and quivering beams, shooting upwards with great rapidity, and yielding a silvery radiance like that of the moon. Frequently a larger arch of light appears, accompanied at the same time by other smaller arches: these move towards each other, and suddenly unite in one splendid mass of radiance. Or, perhaps, one majestic slow-moving arch, of great beauty and effulgence, will suddenly break into countless masses of light, or into numerous smaller arches. Sometimes these arches are brightest towards their centres, at others they are most brilliant at their extremities.

The light of the Aurora is generally white and silvery, but it occasionally presents the beautiful colouring of the rainbow. In high northern latitudes it is mostly white, steel-grey, or pale yellow; but when the sky is clear, or only thin films of cloud are visible, the colours are vivid and prismatic. In Baffin's Bay, the Aurora has been observed distinctly of red, orange, yellow, and green colours. In the north-east of Siberia it is particularly luminous, clothing the sky with a radiance resembling that of "gold, rubies, and sapphires." In Hudson's Bay the light of the

Aurora is frequently equal to that of the full moon, while in Lapland and Sweden the light is still more brilliant, and nearly constant. In this beautiful phenomenon, therefore, the inhabitants of polar regions find a compensation for many of the discomforts and inconveniences of their dreary situation. Even in the Shetland isles the Aurora is a frequent and welcome visitor. Under the title of "merry dancers," the inhabitants hail its appearance as giving beauty and cheerfulness to their long winter nights. It appears soon after the commencement of evening twilight, rising just above the horizon, without particular motion or effulgence, but after a time breaking forth into streams of brilliant light, and assuming every possible variety of form and colour: the stars are visible through the streamers of the Aurora, and they are not greatly dimmed in their lustre, unless the light is of remarkable brilliancy. Objects on the earth may also be observed through these transparent beams. A splendid Aurora was obsered by Captain Parry actually shooting its beams between the observer and the land, the latter being only three thousand yards distant.

The cause of the Aurora has never been satisfactorily explained. It is, however, usually attributed to electricity, which, in its passage from the north pole to the equator, is supposed to become visible in this form. The beautiful imitation of the streamers of the Aurora, which can be obtained from the electrical machine, seems to favour this view; yet it is remarkable that the magnetic needle has never been visibly affected by the Aurora even in those countries where the phenomenon is the most splendid. This is still, therefore, one of those wonderful displays of Divine Power which we must admire, without being able, in the present state of our knowledge, to explain or understand. The Aurora has also been seen in high southern latitudes, but destitute of colour. In this situation it has been called Aurora Australis, or Southern Daybreak.





THE GEYSERS, OR BOILING SPRINGS OF ICELAND.

ICELAND is an island situated in the Northern Occan, amid regions of ice and snow; yet it gives abundant evidence of the volcanic fires which are slumbering beneath its surface. Among the remarkable features of this interesting island are its hot springs, which, in some places, throw up a column of water to the height of a hundred feet, accompanied by a tremendous noise. These springs abound in many parts of the coast, as well as in the interior of the island, and, in some cases, the waters of the ocean are sensibly heated by their action. The most celebrated of these hot springs are the Geysers, situated in the north of the island, where within the space of a few acres more than fifty of them may be seen. Some emit hot water as clear as crystal; others send out hot vapours and troubled waters.

vapours and troubled waters.

The great Geyser, which has attracted most attention, rises from a mound of flinty earth, deposited by the water to the height of about thirty feet, and extending about two hundred feet across. On the top of this mound is the basin, sixty feet wide, and seven feet deep, in the centre of which is the pipe or opening through which the water rises. The basin and pipe are lined with the same flinty deposit, polished to great smoothness by the constant action of the water; but on the outside of the basin the deposit forms beautiful groups of crystals greatly resembling cauliflowers. Small eruptions of the Geyser take place every two or three hours, but the great eruption occurs only once in about thirty hours. This is preceded by a hollow rumbling sound, and many thundering explosions which cause the ground to quiver violently. Suddenly a vast body of water rises with a fluctuating motion to the height of cighty or ninety feet, accompanied by a thick pillar of vapour. From the principal column smaller veins jet out to a much greater height, while others stream in arches from the cloud of vapour. Much of

the beauty of the column is concealed by the steam, but when this is blown aside by the wind, the water appears shooting upwards in innumerable rays, "spreading out at the top like a lofty pine, and descending in fine rain." The column often descends suddenly, as if its force were exhausted: but it again rises with renewed energy, accompanied by thunders rolling in the earth. The whole eruption continues about ten minutes.

Some of these natural fountains play for a much longer time than the great Geyser, and also send their waters to such a height that they become dissipated in fine spray. The body of water is not so great, but the force of the eruption is quite as remarkable. Large stones thrown in for the amusement of travellers, are projected to such a height as to be nearly lost sight of ere they fall back again into the basin. The flinty matter which these springs deposit causes the eruptions to vary constantly in force and character, and in time destroys the spring by entirely choking up the tube from which the water rises. Immediately after an eruption, the water in the basin is near the boiling point, and lower down in the tube it is said to be forty degrees hotter than boiling water. These Geysers are supposed to be caused by the collection of heated vapours in large cavities of the earth, which at length acquire sufficient force to expel the waters subject to their pressure. The word Geyser signifies in the Icelandic dialect "fury."

Thus amid the wildness and desolation of Icelandic scenery, the simple inhabitants have abundant opportunity of recognising in these magnificent fountains, and in the awful grandeur of volcanoes and volcanic remains, the constant presence and mighty power of their Creator.

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WATER SPOUTS.

THE Ocean presents inexhaustible subjects of contemplation to those who delight to trace the wonderful works of God. "They that go down to the sea in ships, that do business in great waters; these see the works of the Lord, and his wonders in the deep. For he commandeth and raiseth the stormy wind, which lifteth up the waves thereof." (Ps. cvii. 23, 24, 25.) Among the more striking phenomena connected with the ocean are Water Spouts, or sea-whirlwinds, of magnificent appearance. The first symptom of their occurrence is, generally speaking, a violent disturbance of the sea immediately below some dark cloud. Throughout a space perhaps of a hundred yards diameter, the waves are whirled round with great rapidity, and tend strongly towards a centre, at which there is quickly accumulated a large mass of water or aqueous vapour, which rises with a spiral movement in a conical shape towards the cloud. At the same time there is formed in the clouds above a similar cone, but in an inverted position. These two cones gradually approach each other, and at length unite; they are, however, not stationary, but are carried to and fro by the wind, and sometimes burst asunder with a loud noise. While the sea and sky are thus united, the appearance is remarkably grand, the whole column being of a light colour near its axis, but dark along the sides, thus giving it a hollow appearance. The course of the sea water in the interior can sometimes be distinctly seen, moving along the column as smoke up a chimney. The spout is often formed and broken up several times successively in the same spot, the agitation and boiling of the waters continuing the whole time. The danger to ships is imminent, for no vessel coming within the vortex of the waters could possibly escape. Captain Beechy thus describes the narrow escape of his vessel off Clermont Tonnere, near the Gambier Islands. "The Water Spout approached us amid heavy rain, thunder and lightning, and was not seen until it was very near the ship. As soon as we were within its influence a gust of wind obliged us to take in every sail, and the topsails, which could not be furled in time, were in danger of splitting. The wind blew with great violence, momentarily changing its direction, as if it were sweeping round in short spirals. The rain, which fell in torrents, was also precipitated in curves with short intervals of cessation. Amidst this thick

shower, the Water Spout was discovered extending in a tapering form from a dense stratum of cloud to within thirty feet of the water, where it was hid by the foam of the sea, being whirled upwards with a tremendous gyration. It changed its direction after it was first seen, and threatened to pass over the ship, but being diverted from its course by a heavy gust of wind, it gradually receded. On the dispersion of this magnificent phenomemon we observed the column to diminish gradually, and at length to retire to the cloud from whence it had descended."

cloud from whence it had descended."

Water Spouts are sometimes formed from the clouds alone, without communication with the sea. One of these, which appeared in France, is stated to have emitted a strong smell of sulphur, while flashes of lightning proceeded from it, and also a great quantity of water. In 1718 a Water Spout burst in Lancashire, and at the place where it fell the ground was torn up to the extent of about half a mile in length, and to the depth of seven feet, so as to lay bare the surface of the rock underneath. The visible portion of Water Spouts varies in height from two thousand to six thousand feet. The size and colour of the column also greatly vary. The lower portion of those seen at sea has been observed from 100 to 1000 feet in diameter; the middle is sometimes not more than two or three feet. The larger the columns, the longer they endure. They do not generally last more than half an hour, during which time they move along at an uncertain rate. Sometimes they have passed over thirty-seven English miles in one hour; at other times a person on foot can easily follow them. These spouts have also a motion of greater or less rapidity on their own axes. When the motion is violent they have power enough to tear up large trees, move heavy cannon, and wrench off the roofs of houses. Small objects have been carried twenty miles, and a fish-pond has been emptied in an instant.

Water Spouts are always attended with electrical action, and in many

Water Spouts are always attended with electrical action, and in many cases light, noise, and a sulphureous smell accompany them. Yet they do not affect the magnetic needle in ships, even when they actually pass over the vessel. The phenomenon closely resembles, if it is not identical with, the whirlwind, which, in arid plains and deserts, raises pillars of sand and dust of a form very similar to that which is in this case assumed by water.





Glaciers are among the most sublime and wonderful features of Alpine countries. They are vast collections of ice, which fill up the higher valleys and occupy the slopes of lofty mountains. They originate in the partial melting of the snows on the higher mountains and valleys. Durates the state of the snows on the higher mountains and valleys. ing summer, the heat of the sun by day melts a portion of this snow: the water thus formed trickles through the mass, and becoming frozen at night, it serves to bind and consolidate it. It is thus repeatedly thawed by day, and frozen at night, until at length the whole becomes converted into ice, which differs from common ice in being coarser in grain, and less compact. The Glacier thus becomes a river of ice, filling the valleys, and pouring down its mass into the valleys yet lower.

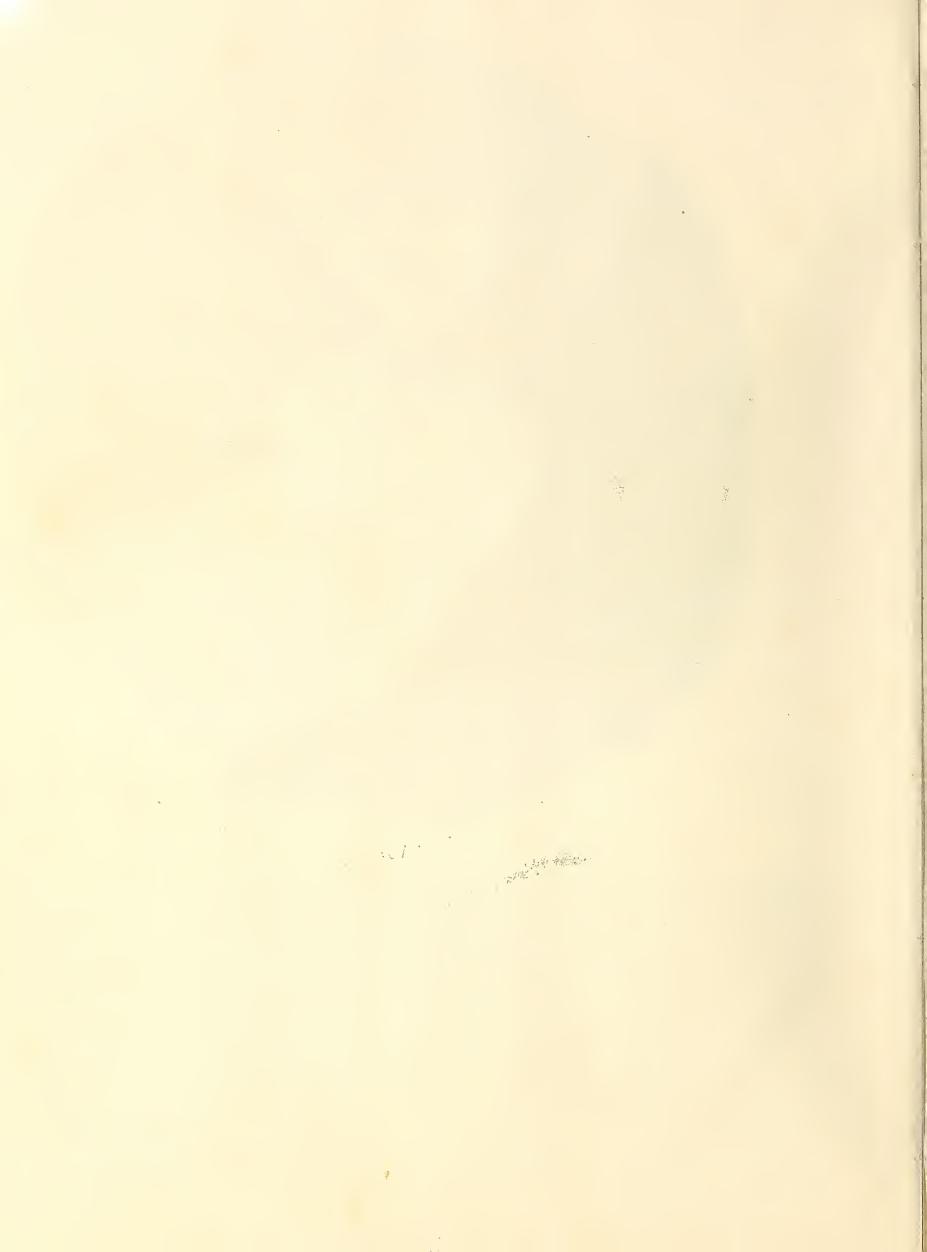
The extent of the Glacier depends greatly upon the slope of the mountain on which it is formed. Where the declivity is steep, the Glacier is small, but on a gradual slope Glaciers have been known to extend twenty miles, protruding a frozen torrent into the midst of warm and pine-clad slopes, and even invading the huts of the peasantry. Professor Forbes remarks that many persons now living have seen the full ears of corn touching the Glacier, or gathered ripe cherries from the tree with one

foot standing on the ice.

The upper part of the Glacier is covered with snow, beneath which are numerous rents or fissures, which extend nearly across it. These fissures, which are also of great depth, are the chief source of danger to those who cross the Glacier, and many a hunter has perished in them. The middle portion of the Glacier is more or less covered with blocks of

stone, which are borne down upon its surface. These stones serve to mark the progress of the Glacier, for "they may be watched from year to year descending the icy stream, whose deliberate speed they mark as a floating leaf does that of a current of water." At the lower part of the Glacier the ice is generally of an exquisite blue colour, which in many places passes into green. At the extremity of the Glacier, the stones and rubbish brought down by it form a transverse ridge, sometimes eighty or a hundred feet high, called the terminal moraine. The Glacier is closed in at the side by icy walls, mingled with masses of rock. Sometimes huge blocks of stone, supported by a column of ice, are found on the Glacier. They are called *Glacier-tables*.

As the Glacier is constantly renewed by the melting of the snow in the upper regions, so it is constantly being wasted by evaporation, and by the natural heat of the earth, which thaws the under surface. This thawing produces an under-flowing current, the action of which, aided by fragments of ice and stones which it bears along, is sufficient to hollow out a lofty cavern or channel beneath the Glacier. From this channel there issues forth an ice-cold stream of turbid water, which makes its way towards one of those vast rivers which traverse our continents. Thus it is, that, by a wise and bountiful arrangement of our Creator, the summer heat, which dries up other sources of water, exerts its mild influence upon the hidden stores of the Glacier, and pours them out with a measured hand, to diffuse gladness and fertility over the lower region of the plains.





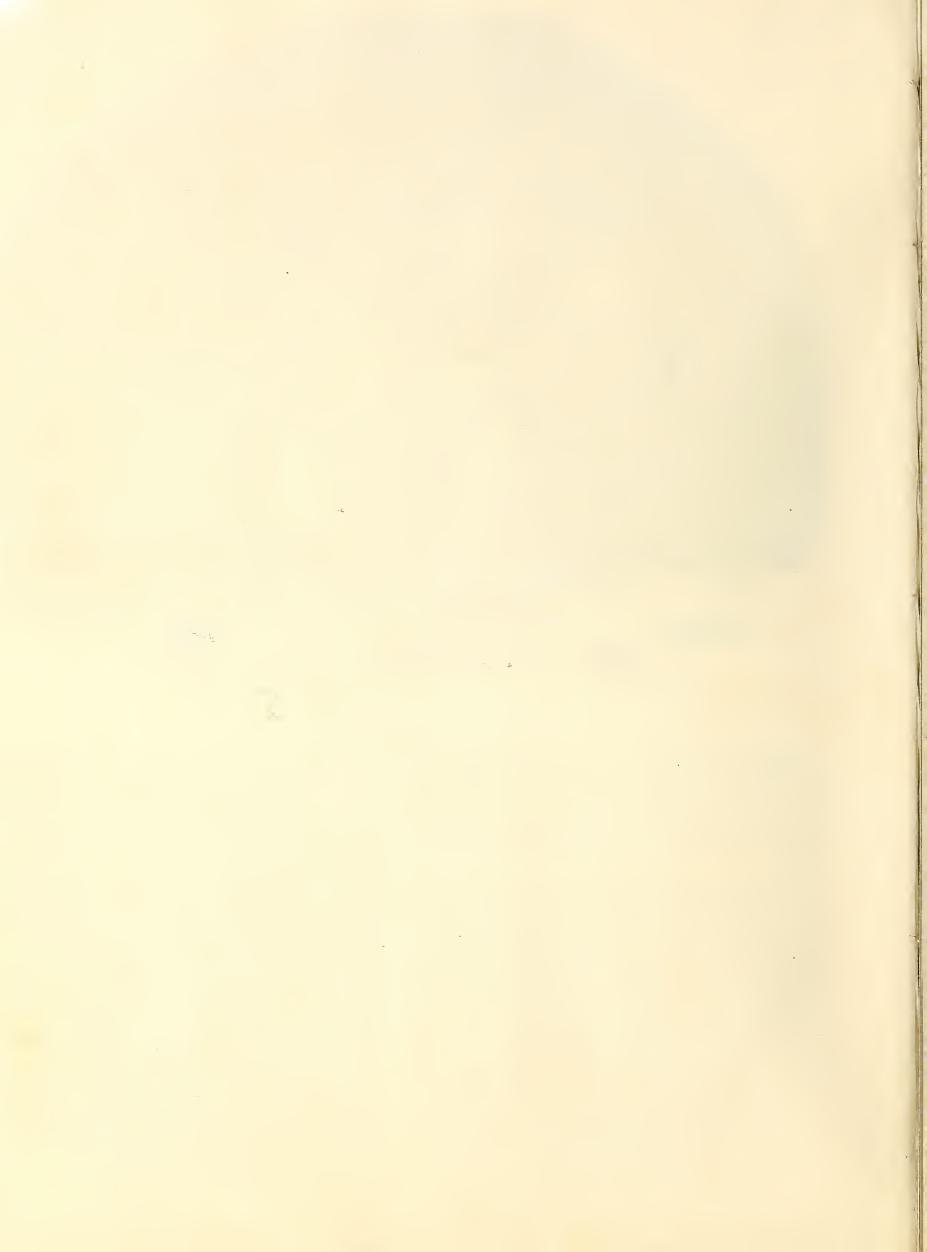
ICEBERGS.

Iceberg, or Ice Mountains, are enormous masses of ice which are formed in the Arctic Regions. They are of two kinds—fixed and floating. A fixed Iceberg, situated to the north of Horn Sound, is described as occupying eleven miles in length of the sea-coast. It rose precipitously from the sea to the height of four hundred and two feet, and extended backwards, towards the summit of the mountain, to about four times that elevation. Its surface formed a magnificent inclined plane of smooth snow; but the lower parts in summer presented a bare surface of ice.

Floating Icebergs are common in the Arctic and Antarctic regions, and are transported by currents to very considerable distances from the places where they were formed. In Hudson's Strait, Davis's Strait, Baffin's Bay, and other parts of the North Atlantic Ocean, they are very numerous, and of an enormous size. They usually have one high perpendicular side, with a gradual slope to the opposite side, which is very low. Their base is commonly much larger in extent than their upper surface. According to Captain Scoresby, the proportion of ice appearing above water is seldom less in elevation than one-seventh of the whole thickness; and when the summit is conical, the elevation above water is frequently one-fourth of the whole depth of the bergs. Some of these floating masses present the most fantastic forms: others resemble palaces, churches crowned with spires, and pinnacles, castles, towers, and arched gateways. A number of them seen at the distance of a few miles greatly resemble a mountainous country. Others have large caverns and hollows, in which the snow water accumulates. Hence the crews of whalers often obtain their supplies of fresh water; while fragments of Icebergs picked up at sea also furnish ships with the same. The ice of these bergs has a fine green tint, verging on blue; but from a distance the whole mass appears to be composed of white marble, except in cases where the ice is mixed with earth, gravel, or sand, which alters its appearance. The

state of the atmosphere also causes some variety in the appearance. Captain Ross says it is hardly possible to imagine anything more exquisite than the variety of tints which Icebergs display: by night, as well as by day, they glitter with a vividness of colour that no art could represent; while the white portions have the brilliancy of silver, the colours of other parts are as various and splendid as those of the rainbow.

In navigating the seas where Icebergs abound, the sailor can scarcely fail to be impressed with the wonderful scene around him, and to feel deeply conscious of the fact that nothing but the immediate protection of the Almighty can so direct these moving mountains as to save his vessel from being crushed between them. In crossing the Atlantic at certain seasons, ships are frequently exposed to this danger; and it is supposed that many ships which have been lost, and not since heard of, have met their fate by being crushed between two Icebergs. In a stormy sea Icebergs make a tremendous noise in rising and falling. They are frequently overturned, or, running aground, they fall to pieces with the noise of thunder, and crush whatever objects they meet with in their descent. Ships have thus been staved, and boats at a considerable distance have been overwhelmed by the vast waves occasioned by the fall of an Iceberg. The awful effects produced by a solid mass, millions of tons in weight, falling from a height of many hundred feet, can be more easily imagined than described. But the heat of a summer's sun produces even more awful effects than a stormy sea. Captain Scoresby says that the Icebergs become hollow and fragile, large pieces break off and fall into the sea with an astounding crash, and the Iceberg is sometimes turned on one side, or even inverted. The sea is thereby put into commotion; extensive fields of ice are broken up; the waves extend, and the noise is heard to the distance of several miles, and sometimes, the rolling motion of the berg not ceasing, other pieces get loosened and detached, until the whole mass falls asunder like a wreck.

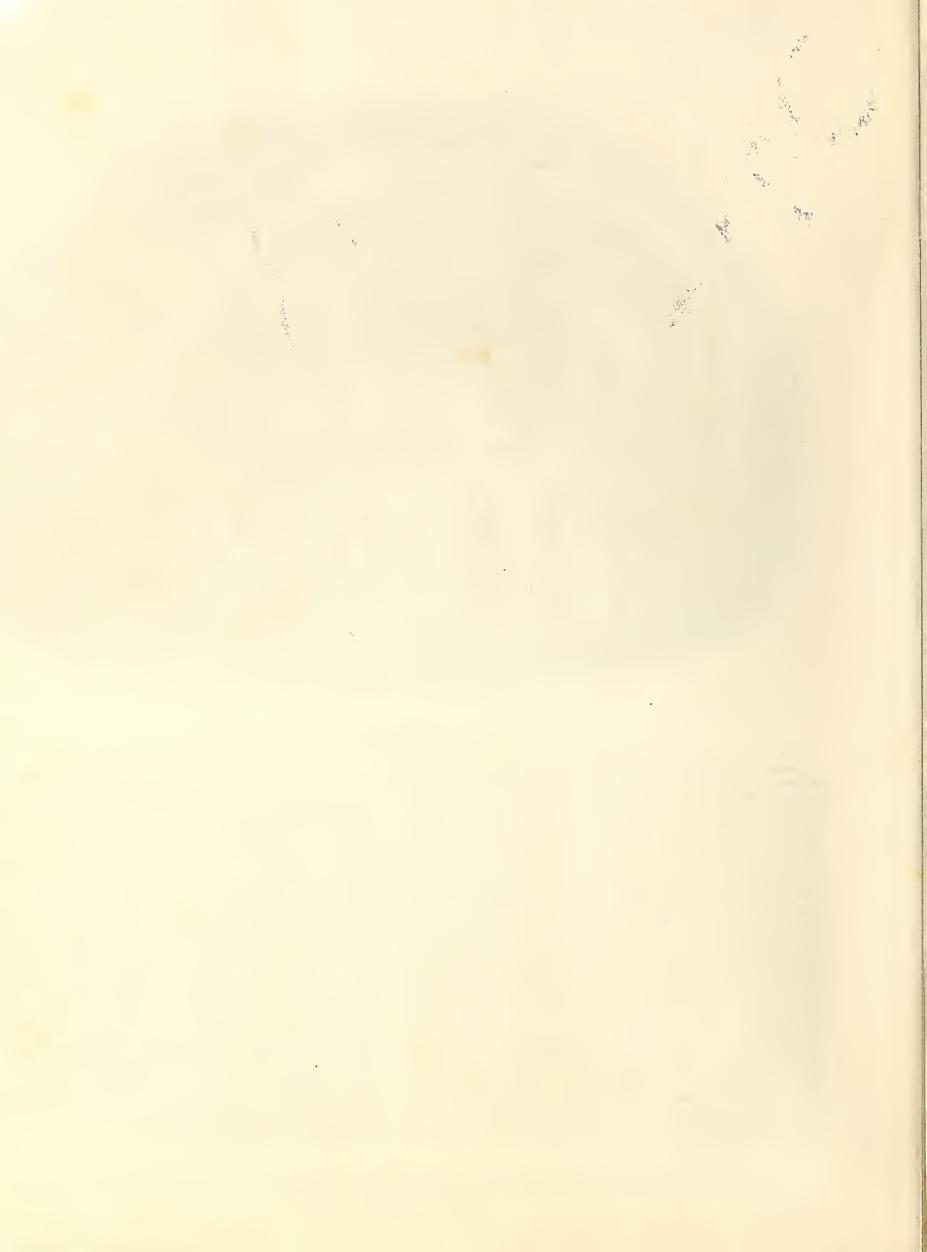


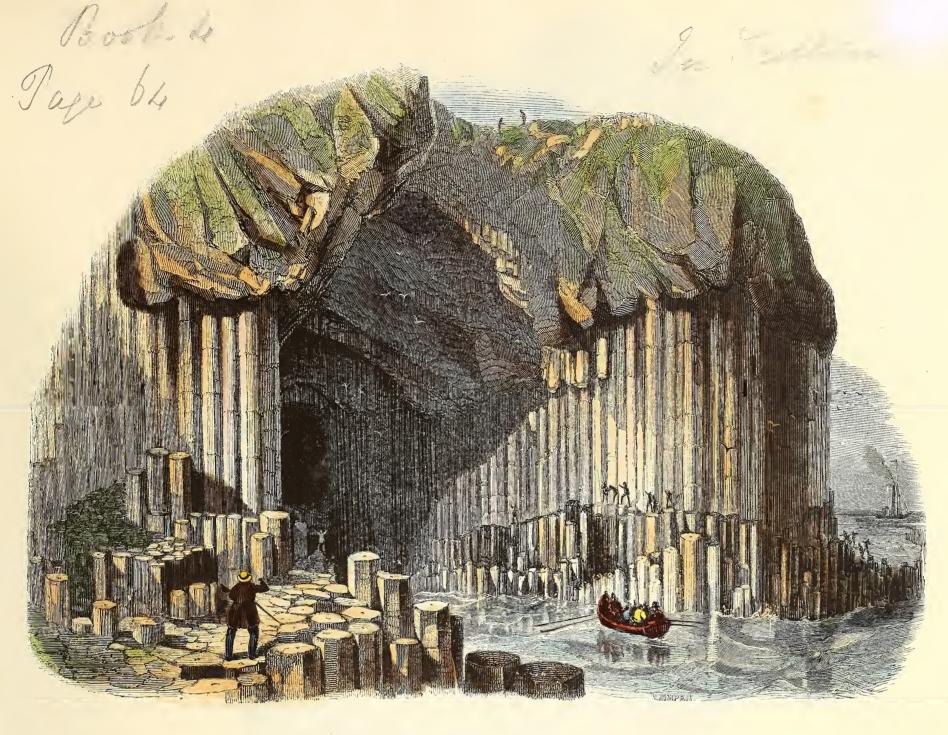


CAVERNS.

Among the grand and beautiful features of the globe are caverns, or natural hollows in the solid crust of the earth, which are found of greater or less extent in most countries. Some of them are wide clefts in the rocks, which appear to have been torn asunder by some powerful agency; others form a series of grottoes, connected by passages; while a third sort admit daylight at both ends, and are frequently traversed by rivers. Some of these caverns are formed by the constant action of water on limestone or gypsum rocks; others are evidently due to volcanic agency. The immense size and extent of many natural caverns have caused them to be highly eelebrated. The cave of Fredericshall in Norway, is said to be eleven thousand feet deep. In the north-west of Georgia, is a cave fifty feet high, and one hundred wide, which has been explored to the distance of several miles. Caverns are frequently adorned in the most magnificent manner with stalactites and basaltic columns. Among these are the celebrated grotto of Antiparos in the Greek Archipelago, the entrance to which, as seen by torchlight, appears studded with diamonds and precious stones, and, in our own country, the cave of Fingal in Staffa, and the Peak cavern, in Derbyshire. Some caverns exhale noxious vapours: the most remarkable example is that of the Grotto del Cane near Naples. Many caverns of volcanic origin exist in Iceland. The most remarkable of these is called Surtshellir or the Black Cavern. It is also called the Cave of the Robbers, from a tradition that it was formerly occupied by successive bands of robbers. It is situated towards the west of the island, in a valley which has been filled up with molten lava. The lava also rises to a considerable height on the side of the adjoining mountains, and the surface of the ground is covered with masses of the same substance broken and distorted into a thousand different forms.

The approach to the cavern is by a large chasm, formed by the falling in of the crust of lava. The mouth of the cavern appears as a dark opening; it is thirty-six feet high, and fifty-four feet wide, which dimensions the cavern retains for more than two-thirds of its length, which is upwards of five thousand feet. When Dr. Henderson visited this place, it was filled to a considerable height with snow, beyond which extended a rugged tract of large angular pieces of lava which had fallen from the vault. The darkness was so great, that with all the light afforded by two large torches, the cave could not be surveyed distinctly, yet beautiful black volcanic stalactites could be discerned hanging from the spacious The sides of the cave had run into vitrified stripes, apparently formed by the flowing of the stream of lava. Farther on in the cave were entrances to other subterranean passages of an immense size, which, it is supposed, had formed the asylum for banditti in ancient times. About ten feet from the bottom of the cave was a long stone wall, visibly made by the hand of man. Within its enclosure was a room of thirty feet in length, by fifteen feet in breadth, the floor of which was strewed with the finest volcanic sand. This probably formed the sleeping place of the inhabitants of the cave. The vault was hung with beautiful stalactites, reflecting the light in a splendid manner. One of the divisions of this cavern represented in the above view produces a very striking effect. It is an ice-grotto, and is thus described by Dr. Henderson, "the roof and sides of the cave were decorated with the most superb icicles, crystallized in every possible form, many of which rivalled in minuteness the finest zeolites, while from the icy floor rose pillars of the same substance, assuming all the curious and fantastic shapes imaginable, and mocking the proudest specimens of art.





FINGAL'S CAVE.

Staffa is one of a group of islands called the Hebrides, or Western Islands of Scotland. It is of an irregular oval shape; about a mile and a half across, and is a sort of table-land, supported by cliffs of various heights. These cliffs are formed of a stone called basalt, which rises up to a great height, in the shape of lofty pillars. In many parts of the coast these pillars have yielded to the action of the sea, and caves have been formed of remarkable beauty.

The caves are most easily seen along the eastern side of the island; the surge, which constantly beats on the other sides, rendering an approach difficult and dangerous. So beautiful and regular are these caves that they appear to have been built up by the hand of man; the lofty columns are like those of a cathedral, supporting a richly carved roof, adorned with various hues, while the ends of innumerable small columns of basalt give the ground the appearance of a tesselated pavement.

The most celebrated of these caves is that known as Fingal's Cave. The entrance is an irregular arch fifty-three feet broad and one hundred and seventeen feet high. The interior is two hundred and fifty feet in length. The sides are straight, and are divided into pillars, some of which, on the eastern side, are broken off near the base, and form a path to the farthest end. The rest of the floor is washed by a deep and often tumultuous sea. In fine weather boats can reach the farthest end of the cave, but with the least swell they are liable to be dashed to pieces. When the sea is boisterous, the waves rush to the farthest extremity with a deafening noise, hurling aloft volumes of spray, and flakes of foam. At the extreme end is a kind of natural throne, from which the spectator commands a fine view of that magnificent hall, which by its beautiful symmetry resembles, yet surpasses, the imitative efforts of man.

Sir Walter Scott says of this wonderful scene, "The stupendous columnar side walls—the depth and strength of the ocean, with which the cavern is filled—the variety of tints formed by stalactites dropping and petrifying between the pillars, and resembling a sort of chasing of yellow or cream-coloured marble, filling the interstices of the roof—the corresponding variety below, when the ocean rolls over a red, and in some places a violet coloured rock, the basis of the basaltic pillars—the dreadful noise of those august billows, so well corresponding with the grandeur of the scene—are all circumstances elsewhere unparalleled." The same writer notices the cave in poetical language, thus:—

"Here, as to shame the temples deck'd By skill of earthly architect, Nature herself, it seemed, would raise A minster to her Maker's praise! Not for a meaner use ascend Her columns, or her arches bend; Nor of a theme less solemn tells That mighty surge that ebbs and swells, And still, between each awful pause, From the high vault an answer draws In varied tone prolonged on high That mocks the organ's melody. Nor does its entrance front in vain To old Iona's holy fane, That Nature's voice might seem to say 'Well hast thou done, frail child of clay! Thy humble powers, that stately shrine Task'd high and hard—but witness mine!""





THE FALLS OF NIAGARA.

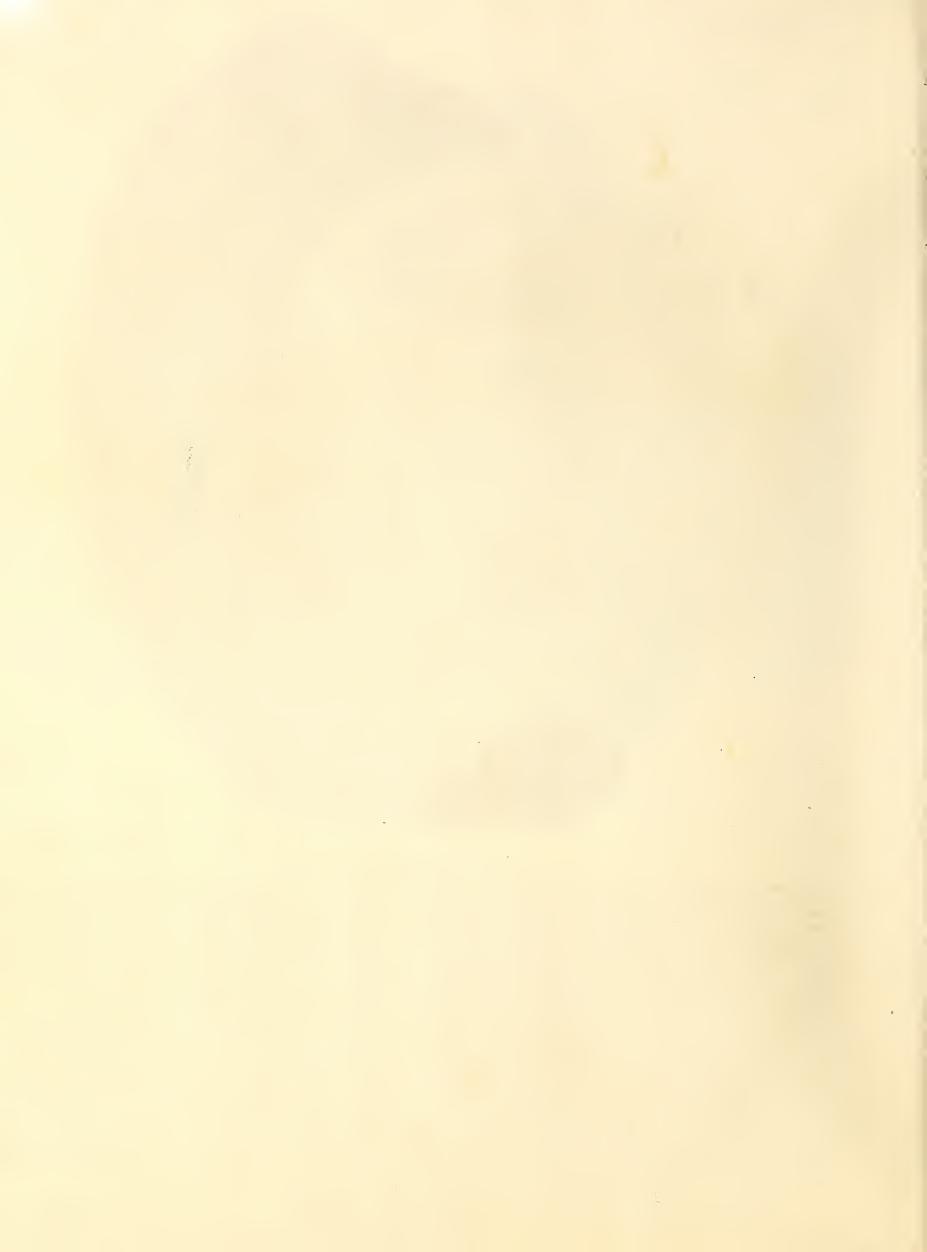
NIAGARA is a large river of North America uniting Lake Erie with Lake Ontario. The distance between these lakes, through which the river has to descend, is about thirty-three miles, and the difference in level is three hundred and thirty-four feet. For the first twelve or fourteen miles the river flows with a gentle current. Its width is about a mile, until it arrives at Grand Island, where the stream is divided into two arms. About ten miles lower down these arms unite, and the width then becomes about two miles. After this it suddenly contracts to less than a mile, and the rapidity of the current increases from three to seven or eight miles an hour. The banks of the river soon rise from ten to fifty feet, and the waters proceed with great force and rapidity over a series of rapids until their course is changed by high rocky banks, and the waters seem for a moment to regain their tranquillity. But again rushing on, the stream is divided by a small island into two unequal channels, and gaining a tremendous impetus by means of a steep inclined plane, the whole mighty mass of waters is suddenly projected over the edge of a rock, one hundred and sixty feet in perpendicular height, into a black and boiling gulf below. The principal mass falls on the Western or Canada side, and is about seven hundred yards wide. The other portion falling on the American side, is subdivided into two portions by a small rock, and has a perpendicular fall one hundred and sixty-four feet, and a width of three hundred and twenty yards. The Canadian Fall is gene-

rally known as the "Horse-shoe Fall," from the curved form of the ledge of rocks over which it is precipitated. Both these great bodies of water unite before they are lost in the gulf below. From the projecting form of the rocks, and from the tremendous force of the torrent, the waters of the Horse-shoe Fall are sent forward to the distance of fifty feet from the base of the rock, so that visitors may pass behind this watery wall into a cavern, whither, at the expense of being drenched with spray, many have had the courage to repair. The vast body of water admits, as through a curtain, a greenish light into the interior.

The united waters fall for the most part in one unbroken sheet of a

The united waters fall for the most part in one unbroken sheet of a dark green colour, until they meet a cloud of spray ascending from the rocks below. They then become lost to the eye, and the cloud of vapour rises one hundred feet above the precipice, and can be seen at the distance of seventy miles. Prismatic colours are always present, and complete rainbows, sometimes three at a time, and of the most brilliant hues, delight the eye. Below the Falls the river flows rapidly for four miles between banks from two to three hundred feet high. It then forms a terrific whirlpool, and rushes out at a narrow passage between perpendicular cliffs, whence it soon descends into the level country about Lake Ontario.

The thunder of the cataract has been heard at a distance of forty-six miles; hence the name given to these stupendous Falls, which, in the Indian language, signifies the *voice of thunder*.





THE PRAIRIE ON FIRE.

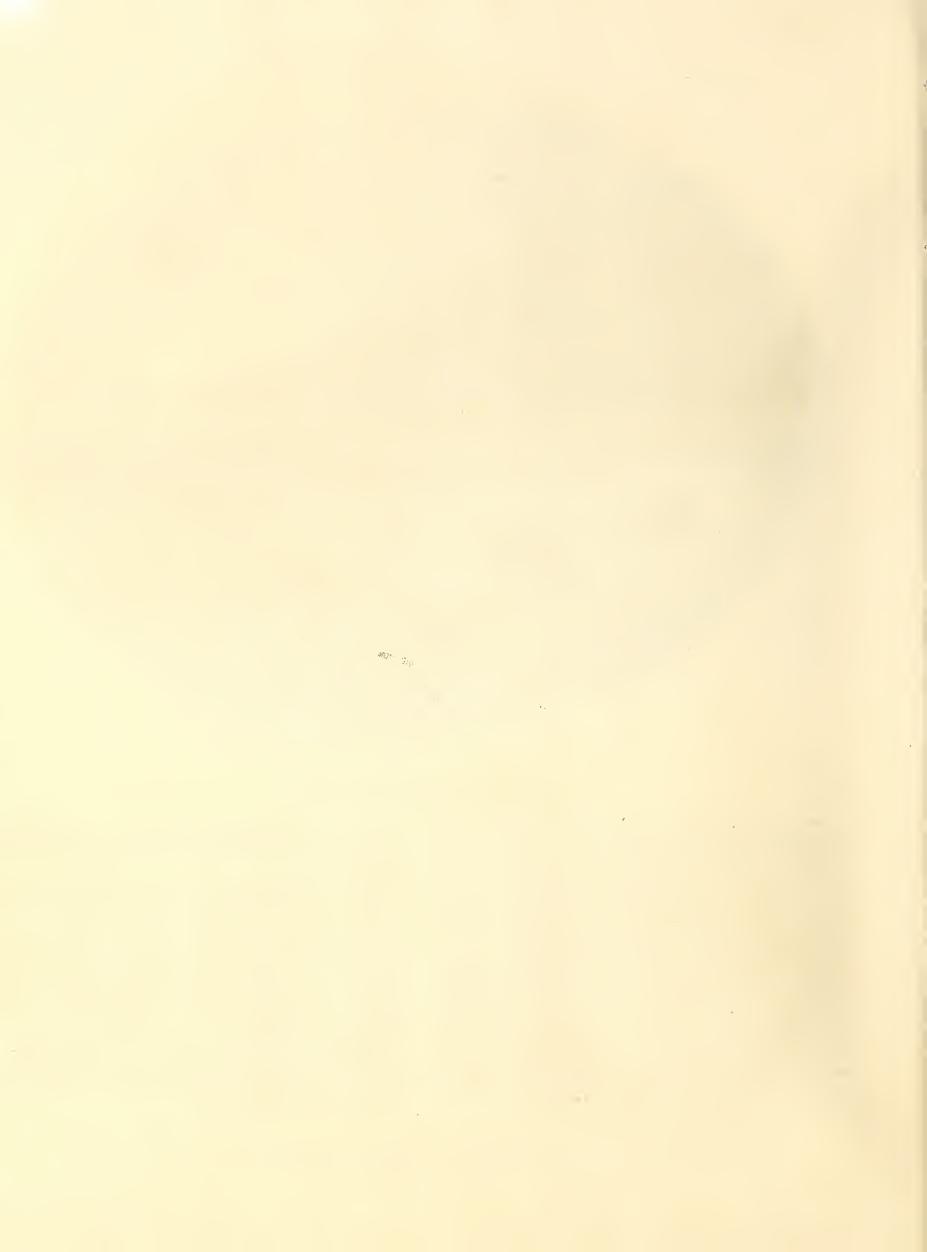
Some of the central parts of North America are occupied by vast plains destitute of water, and almost of all vegetation but grass. They are called *Prairies*, from a French word signifying a meadow. The surface sometimes swells into a hill called a prairie-bluff, but more frequently, the horizon everywhere presents a perfectly straight line, and nothing is seen to rise above it. "The traveller," says Catlin, "feels weak and overcome when night falls; and he stretches his exhausted limbs apparently on the same spot where he slept the night before, with the same prospect before and behind him, the same canopy over his head, and the same cheerless sea of green to start upon in the morning."

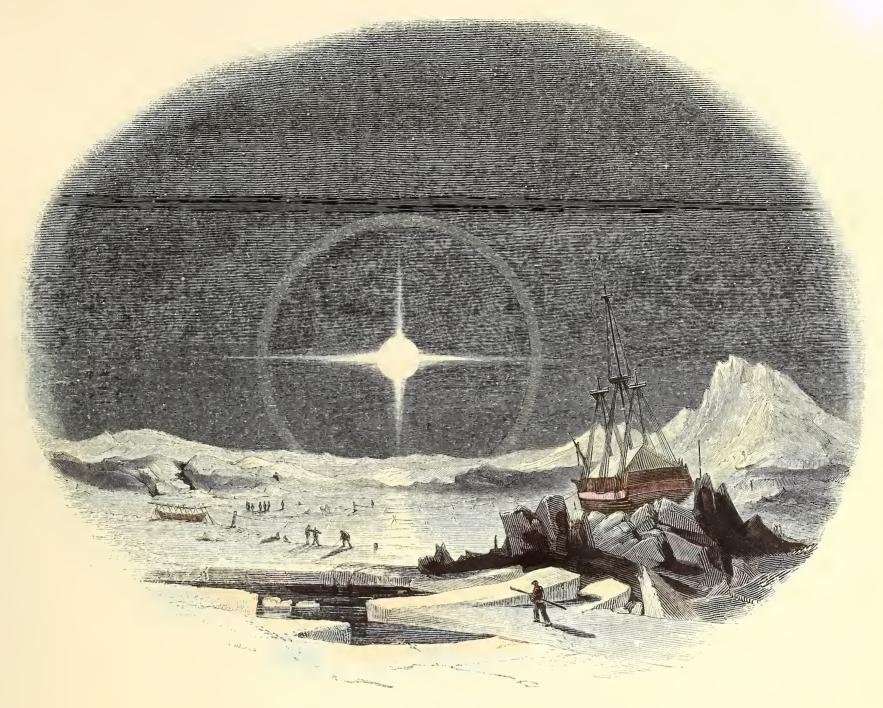
This vast crop of grass having ripened its seed, dies, and is converted by the heat of the sun and the wind into a dry and inflammable mass. In Autumn or early in the Spring it frequently catches fire, and the progress of the flames is not arrested, except by a river or by heavy rain. The Prairie is sometimes set on fire accidentally by white men or by Indians; at other times it is done purposely, in order to get a fresh crop of grass for their horses, and also to enable them in the following Spring to travel with greater ease by getting rid of the old grass, which entangles the feet of men and horses. The fire is comparatively harmless while it creeps along the elevated lands and prairie-bluffs, where the grass is short and thin. The feeble flame creeps slowly along, and both men and ani-

mals can easily leap over it and escape injury. At night it presents a beautiful appearance, the bluff itself being lost to view, and the chains of liquid fire, as it would seem, hanging in brilliant and sparkling festoons from the sky.

But in meadows where the grass is seven or eight feet high, a fire is a sublime and terrific spectacle. The vast body of flame urged by a strong wind travels at a fearful rate, and often destroys parties of Indians who are overtaken by it: not that the fire travels as quickly as a horse at full speed, but that the high grass is filled with wild pea-vines, and other impediments, which often compel the rider to follow the zig-zag track of the deer and the buffalo. This retards his progress, and he is soon overtaken by dense clouds of smoke, which terrify and bewilder the horse, so that he refuses to proceed. The suffocating smell of burning vegetable matter, the roar of the flames resembling that of a cataract, and the red glare of light, as from some vast furnace, complete the awful character of the Prairie-fire.

All animals flee before this fiery tempest. The screaming eagle, the swift-winged beetle, and heath-hen, the antelope, and the long-legged hare, all contend with the horse and his rider, in the endeavour to gain some distant prairie-bluff, a small island rising above a sea of fire, where they can rest until the danger is over.





HALOS.

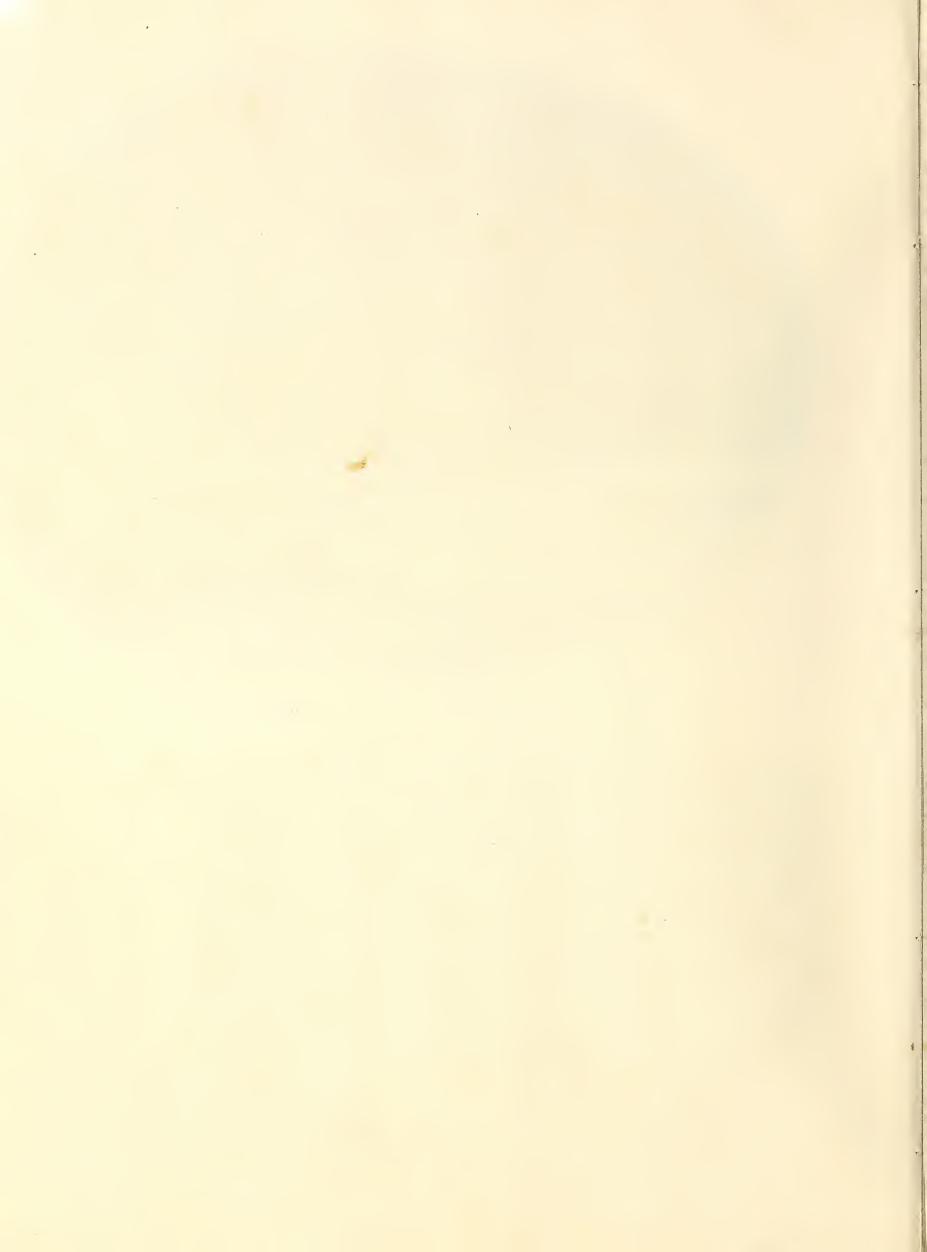
In certain states of the atmosphere, chiefly occurring in Polar Regions, the sun and moon are surrounded with circles and parts of circles of various sizes and forms, producing the most singular and remarkable effects. All these appearances are called *halos*. The small halos seen round the sun and moon in fine weather, when the sky is partially covered with light fleecy clouds, are also called *coronæ*. Sometimes the image of the sun or moon is repeated several times, producing what are called *parhelia*, or mock-suns, and *paraselenæ*, or mock-moons.

A few years ago a beautiful exhibition of parhelia occurred in the northern parts of America. The atmosphere had been very hazy, but as the haziness cleared off the first appearance was a brilliant parhelion. "Its form at first was nearly circular, and its apparent diameter a little greater than that of the true sun. Its light, which was of a brilliant white, was so intense as to pain the eyes. In a few moments, another parhelion, of equal brightness, appeared at the same distance on the east side of the sun, and at the same altitude. When first seen it appeared a little elongated vertically, and slightly coloured. Both these parhelia retained their size and appearance for a few moments, and then began to lengthen in a vertical direction, and show the prismatic colours with considerable brilliancy. Directly above the sun appeared, at the same time with the parhelia, a coloured arc, having its centre in the zenith, and its convexity towards the sun. The exterior was red; the other colours were merged into each other, but the blue and green were predominant, though faint."

Paraselenæ are frequently seen in the Polar Regions. Captain Parry noticed several of them during the long winter nights of those dreary abodes. On the 1st December, 1819, he remarked one close to the horizon; another perpendicularly above it; and two others on a line parallel to the horizon. "Their shape was like that of a comet, the tail being from the moon. The side towards the moon was of a light orange colour. During the existence of these mock-moons, a halo, or luminous

ring, appeared round the moon, and passed through all the mock-moons, at which instant two yellowish coloured lines joined the opposite mockmoons and formed four quadrants, bisecting each other at the centre of These appearances varied in brightness, and continued above On another occasion a circular halo surrounded the moon: part of a well defined circle of white light passing through the moon, extended for several degrees on each side of her, and in points where this circle intersected the halo were paraselenæ. In the part of the halo immediately over the moon was another much brighter, and opposite to it in the lower part of the circle another similar but much more faint. About the same time on the following evening two concentric circles were observed round the moon, upon the inner of which were four paraselenæ exhibiting the colours of the rainbow. evening he saw a halo which had in it three paraselenæ, very luminous, but not tinged with prismatic colours, and on the following day the same phenomena occurred with the addition of a vertical stripe of white light proceeding from the upper and lower limbs of the moon, and forming, with a part of the horizontal circle seen before, the appearance of a cross. There was also at times an arc of another circle touching the halo, which sometimes almost reached to the zenith, changing the intensity of its light, very frequently not unlike the Aurora Borealis.

In former ages such appearances produced great terror; but their cause is now known. In cold regions, the vapour of the atmosphere being frozen, innumerable particles of ice, of an angular form, fill the air, and refract and sometimes decompose the rays of the sun and moon. In the Arctic Regions, at the time when halos are most frequently seen, the particles of floating ice prick the skin like needles, and raise blisters on the face and hands. In temperate regions halos are only observed during cold weather, and in the Torrid Zone they never occur; the cold not being sufficient to freeze the vapour of the atmosphere.





CORAL-REEFS.

Some parts of the ocean are studded with a peculiar kind of rock, very narrow, but stretched out to a considerable length. It is called a Coral-reef, and is produced by innumerable small zoophytes popularly called *Coral-insects*. The Coral-insect consists of a little oblong bag of jelly closed at one end, but having the other extremity open, and surrounded by tentacles or feelers, usually six or eight in number, set like the rays of a star. Multitudes of these minute animals unite to form a common stony skeleton called *Coral*, or *Madrepore*, in the minute openings of which they live, protruding their mouths and tentacles when under water, but suddenly drawing them into their holes when danger approaches. These animals cannot exist at a greater depth in the sea than about ten fathoms, and as the Coral islands often rise with great steepness from a sea more than three hundred fathoms deep, it would seem that a great alteration must have taken place in the depth of the ocean since the time when the little architects commenced their labours. Their mode of working is to build up pile upon pile of their rocky habitations, until at length the work rises to such a height that it remains almost dry at low water. A solid rocky base being thus formed, sea-shells, fragments of coral, sea-hedge-hog-shells, and prickles are united by the burning sun and the cementing calcareous sand into a solid stone, which gradually increases in thickness, till it becomes so high that it is covered only by the spring tides. The heat of the sun so penetrates the mass of stone when it is dry, that it splits in many places, and breaks off in flakes. These flakes are raised by the active surf, and thrown, with sand and shells of marine animals, between and upon the foundation stones, where they offer to the seeds of trees and plants, cast up by the waves, a soil upon which they rapidly grow, overshadowing the dazzling white surface. Trunks of trees, carried by rivers from other countries and islands, find here at length a resting-place; with these come small animals, such as

lizards and insects, as the first inhabitants; sea-birds nestle there; strayed land-birds take refuge in the bushes; and at a much later period man also appears, and builds his hut on the fruitful soil.

Reefs are of various forms. In some places they occur at a great distance from the land, and run nearly parallel with it: these are called barrier-reefs, and are often of enormous dimensions. Usually a snow-white line of great breakers, with here and there an islet crowned by cocoa-nut trees, separates a broad channel of smooth water from the waves of the open sea. In other places Coral-reefs fringe the shore, and are separated from it by a narrow channel of moderate depth: these are called fringing or shore-reefs.

But perhaps the most remarkable form of reef is that to which the term Lagoon-Island has been applied. In this case the reef approaches the form of a circle; and, surrounding a part of the sea, produces a sheet of smooth water called a lagoon, or lake, within which are usually several smaller islands. From this circumstance the word island, as applied to the whole, has been objected to, and the term atoll substituted, which is the name given to these circular groups of Coral islets by the inhabitants of the Indian Ocean.

"Every one," says Mr. Darwin, "must be struck with astonishment when he first beholds one of these vast rings of Coral rock, often many leagues in diameter, here and there surmounted by a low verdant island with dazzling white shores, bathed on the outside by the foaming breakers of the ocean, and on the inside surrounding a calm expanse of water, which, from reflection, is of a bright but pale green colour. The naturalist will feel this astonishment more deeply after having examined the soft and almost gelatinous bodies of these apparently insignificant creatures, and when he knows that the solid reef increases only on the outer edge, which, day and night, is lashed by the breakers

of an ocean never at rest."





NATURAL BRIDGES.

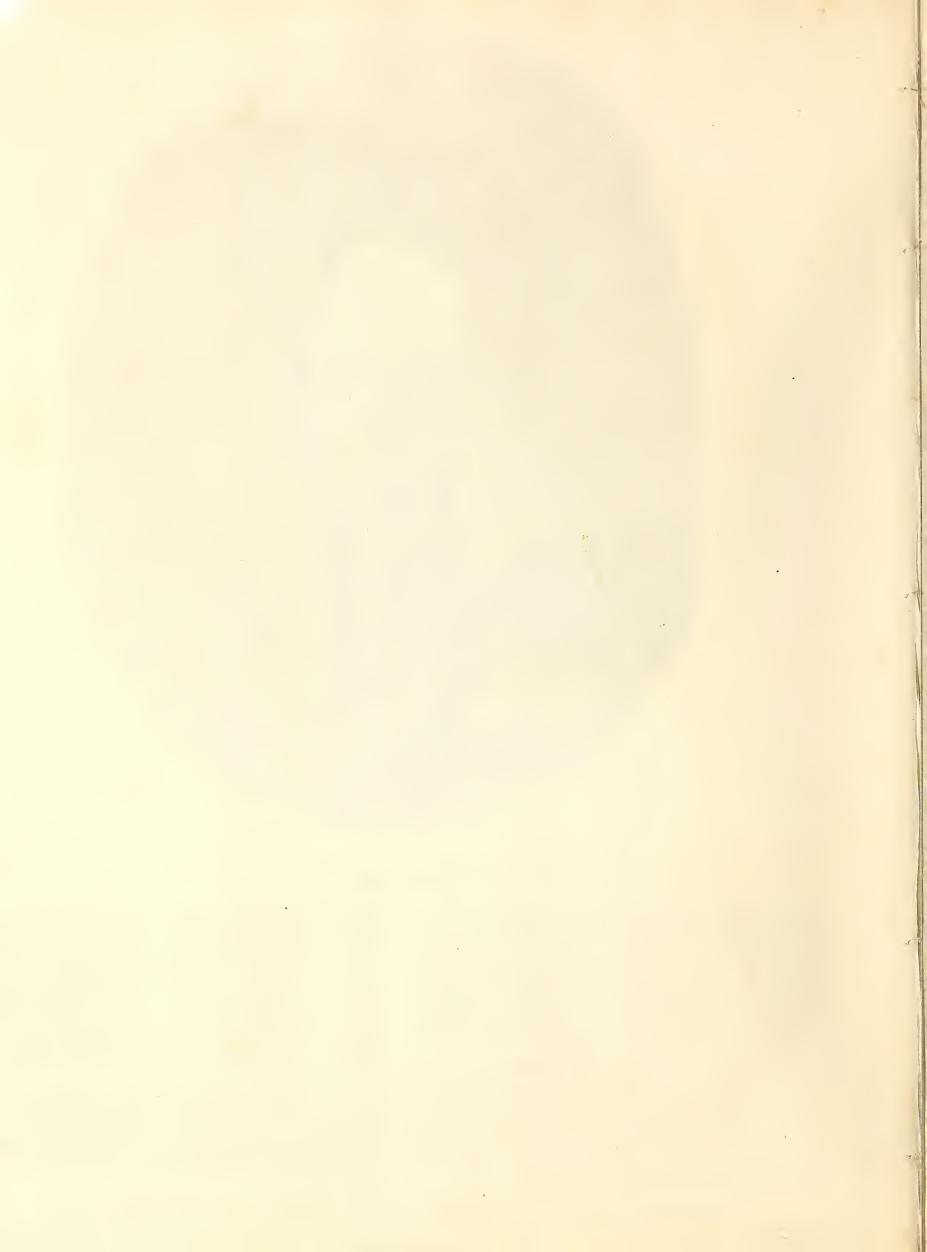
The mountain chains of America are distinguished from those of Europe by perpendicular rents or crevices, which form very narrow vales of immense depth. Those which occur in the Andes are covered below with vegetation, while their naked and barren heads soar upwards to the skies. The crevices of Chota and Cutaco are nearly a mile deep. These tremendous gullies oppose fearful obstacles to travellers, and the task of crossing them is one of great toil and danger. They usually perform their journeys sitting in chairs fastened to the backs of men called cargueros or carriers. These porters are mulattoes, and sometimes whites, of great bodily strength, and they climb along the face of precipices bearing very heavy loads.

But sometimes these crevices are crossed by natural Bridges, which seem to be peculiar to the new world. Those of Icononzo, or Pandi, in New Granada, are very remarkable. They unite two rocks, and beneath them roars a torrent. The rocks are formed of two different kinds of sandstone, the one hard and compact, and the other soft and slaty. The crevice is supposed to have been formed by an earth-quake, which tore away the softer stone while the harder resisted the violence of the shock. This natural arch is forty seven feet long, forty feet broad, and six feet and a half thick in the middle, and is more than eight hundred feet above the surface of the torrent. Under

this Bridge, at the distance of nearly seventy feet, is another arch, composed of three standing blocks of stone wedged together: these are supposed to have fallen from the roof at the same instant of time, and striking against the sides of the crevice became suddenly fixed.

A beautiful example of a natural arch is represented in the above engraving. It crosses the Cedar Creek in Rockbridge county, near Fincastle, in the higher district of Virginia. The rock, which is of pure limestone, is tinted with various shades of grey and brown. The chasm is about ninety feet wide, and the walls two hundred and thirty feet high: these are covered here and there with trees and shrubs, which also overhang from the top, and numerous gay flowers adorn the dazzling steeps. The Bridge is of such solidity that loaded waggons can pass over it.

A recent writer, describing a visit to this Bridge, says:—"It was now early in July; the trees were in their brightest and thickest foliage; and the tall beeches under the arch contrasted their verdure with the grey rock and received the gilding of the sunshine, as it slanted into the ravine, glittering in the drip from the arch, and in the splashing and tumbling waters of Cedar Creek which ran by our feet. Swallows were flying about under the arch. What others of their tribe can boast of such a home?"





MONSOONS.

In the Indian Ocean certain periodical winds prevail, which blow for nearly six months of the year in one direction, and for the other six in an opposite direction. The Malays call them *Mooseen*, which signifies year or season. In English, this term has been corrupted into Managers.

These winds blow with most regularity between Hindustan and the eastern coast of Africa. When the sun is south of the equator, that is, from October to April, a north-east Monsoon prevails; but when the sun is north of the equator, that is, from April to October, a south-western current becomes established. When the sun passes the equator and the Monsoons are changing their direction, variable winds or tempests generally occur. This disturbance is called by seamen the break-

ing up of the Monsoons.

This change is the harbinger of the rainy season in India, and is ushered in by violent storms. The approach of the south-west Monsoon is announced by vast masses of clouds which rise from the Indian Ocean and advance to the north-east, gathering and thickening as they get near to the land. After some threatening days the sky assumes a troubled appearance in the evenings, and the Monsoon generally sets in during the night. It begins with violent blasts of wind succeeded by floods of rain. For some hours lightning is seen almost without intermission, and the thunder bursts on the ear with a sudden and tremendous crash. At length the thunder ceases, and nothing is heard but the continual pouring of rain and the rushing of rising streams. The next day presents a

gloomy spectacle; the rain still descends in torrents and scarcely allows a view of the blackened fields; the rivers are swollen and discoloured, and sweep down along with them the hedges, the huts, and the remains of the cultivation carried on during the dry season.

of the cultivation carried on during the dry season.
"This lasts for some days, after which the sky clears and discovers the face of nature changed as if by enchantment. Before the storm, the fields were parched up, and except in the beds of the rivers scarce a blade of vegetation was to be seen. The clearness of the sky was not interrupted by a single cloud, but the atmosphere was loaded with dust: a parching wind blew like a blast from a furnace, and heated wood, iron, and every solid material even in the shade; and immediately before the Monsoon this wind had been succeeded by still more sultry calms. But when the first violence of the Monsoon is over the whole earth is covered with a sudden but luxuriant verdure; the rivers are full and tranquil; the air pure and delicious; and the sky is varied and embellished with clouds. The effect of this change is visible on all the animal creation, and can only be imagined in Europe by supposing the depth of a dreary winter to start at once into all the freshness and brilliancy of spring. From that time the rain falls at intervals for about a month, when it comes on again with great violence; and in July the rains are at their height: during the third month they rather diminish, but are still heavy; and in September they gradually abate, and are often suspended till near the end of the month, when they depart amid thunders and tempests as they came."*

* Elphinstone's Caubul.





SNOW-BRIDGES.

In ascending snowy mountains, the traveller frequently passes over immense fields of ice, called glaciers. These abound in cracks or fissures, which he has to cross over or to travel round, in his laborious journey. Sometimes the glacier is rent almost from side to side, and the chasm thus formed, becomes the receptacle of avalanches or enormous masses of ice and snow, which fall from the upper regions of the mountain. In their fall these masses occasionally become lodged half in, half out of the chasm, and thus form a bridge by which it may be crossed. Travellers who have reached the summit of Mont Blanc, describe the crevices in the upper regions of that mountain as most singular, awful, and subline spectacles. Approaching cautiously the edge of one of these yawning chasms, those who have sufficient steadiness of nerve may look down on a gulf of unknown depth, whose lower parts are clouded in darkness, but whose sides display all the magnificence of icy crystallization, the smooth walls being covered with a net-work of hoar-frost, more delicate than gauze, and more varied than hangings of damask; while round the edge of the chasm frequently hang the most superb icicles, clear as crystal.

In the ascent to Mont Blanc is a valley or frozen lake, called the Grand Plateau, enclosed on three sides by mountains, and on the other by glaciers. A wide chasm separating the glacier from the Plateau has to be crossed by travellers, the means of communication being an immense mass of snow, which has become lodged in the crevice, and which serves the purpose of a bridge. Our engraving represents this remarkable bridge, and a party of travellers who had the boldness to make that

dangerous situation their resting place, and even breakfasted on the bridge. One of them (Mr. Auldjo) thus describes the scene:—"While breakfast was preparing I could not resist the temptation of wandering along the edge of the crevice on the Plateau side. The depth of it was immense; its great breadth affording me an opportunity of a more accurate and perfect examination than I had had before. The layers of ice forming the glacier, varying in colour from deep bluish-green to a silvery whiteness, with myriads of long clear icicles hanging from all the little breaks in the strata, presented a scene of the greatest beauty. From this point I had a view immediately under our bridge: the manner in which it hung suspended, with all the guides sitting on it, many hundred feet from the bottom of this stupendous chasm, was a beautiful and curious, but at the same time an appalling sight. In one moment, without a chance of escape, the fall of the bridge might have precipitated them into the gulf beneath. Yet no such thought ever entered the imagination of my thoughtless but brave guides, who sat at their meal singing and laughing, either unconscious or regardless of the danger of their present situation."

In the awful solitudes of these mountains, the traveller feels almost oppressed with the sense of his own insignificance. He seems a mere atom, a speck in creation, and he turns with renewed gratitude to that revelation which assures him of the merciful regard of the Framer of all these wonders, who does not overlook the meanest objects, and without whom not even a sparrow falleth to the ground.





RAPIDS.

Large rivers are usually divided by geographers into three portions, which are ealled their upper, middle, and lower courses. The upper eourse of a river is often situated among mountains at a great height above the level of the sea. When the elevation of the mountain region rapidly decreases, the current of the river moves with great swiftness, forming either rapids or cataracts; the former occurring when the bed of the river is continuous, though steep; and the latter when it is broken by sudden and precipitous rocks, over which the water descends by a leap. The middle course of a river generally lies among hills, and the lower course through a plain, where a very gentle slope conveys the waters to the ocean.

The Rapids and Cataracts of the upper course of a river generally prevent all navigation; and when Rapids occur, as is sometimes the case, in the middle course, they occasion great inconvenience. In some of the rivers of America, Rapids are seen from a great distance by the dashing of white foam, resembling the tossing of the occan. People descend the Rapids in long boats made for the purpose. On approaching them the boat gradually increases in speed, until it is hurried away by the waters at a fearful rate. When the bottom is very rocky, the speed is somewhat checked by eddies; but the waves frequently strike the boat with such violence as to threaten its immediate destruction. When the water is very transparent, the pointed rocks have an alarming appearance; for they seem to be close to the surface. In some Rapids there are channels called "lost channels," from the accidents which have happened in them, and it often requires great skill to prevent the boat being

carried into them. Some of these Rapids are many miles in length, and the sensation of sailing down hill is said to be most singular. The boat moves with such fearful rapidity that no one can look at it from the shore without shuddering, and yet the danger is more apparent than real, for accidents seldom occur, and even by ladies the descent of the Rapids is regarded as one of the common modes of travelling.

In ascending the Rapids on the river St. Lawrenee, flat-bottomed boats made of pine boards are used: they are narrow at the bow and stern, and are about forty feet long, and six feet aeross the centre. Each boat earries about five tons, and is navigated by four men and a pilot. Four or five such boats generally form a party, and in them all the merchandize destined for Upper Canada is conveyed. When the current is very strong, the men propel the boat by means of poles about nine feet long, shod with iron, which they press against the bed of the river. This is extremely hard work, and often has to be continued for hours together. But in some parts the Rapids are too strong to allow them to proceed in this way, and almost every hour, when melting with heat and fainting with fatigue, the boatmen are compelled to jump into the water, frequently up to their shoulders, and tow the boat along by main strength, leaving only the helmsman on board. In this way they are about ten days in performing a journey of one hundred and twenty miles. There are several Rapids between Montreal and Prescott, some of which are about nine miles in length, and though they are seldom ascended in less than a day, boats have been known to descend through their whole length in fifteen minutes.





PETRIFYING SPRINGS.

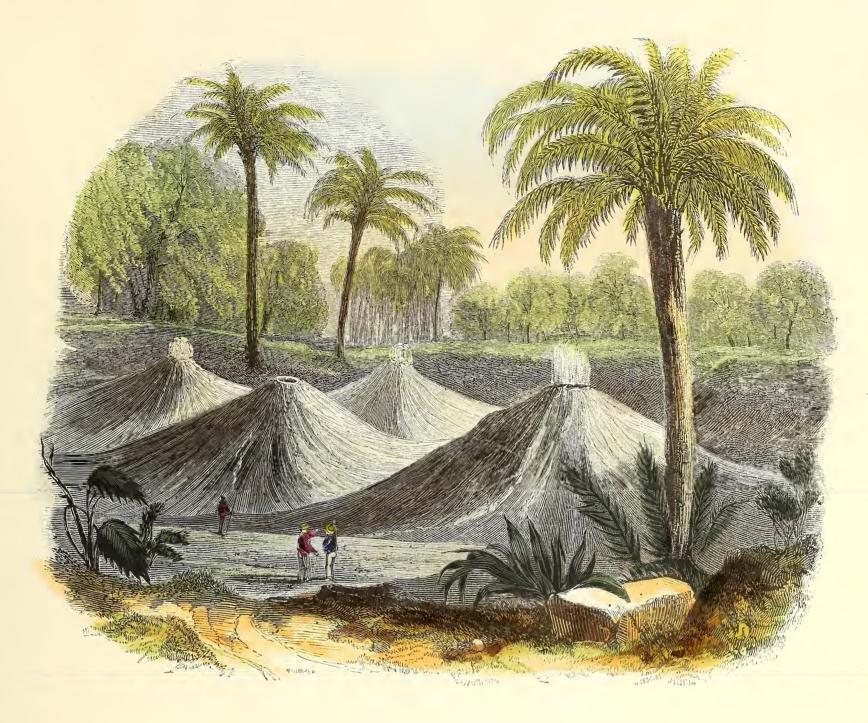
In volcanic regions, or in those where earthquakes have occurred at a comparatively recent date, springs are frequently loaded with mineral substances, which they abundantly deposit in their course. In many parts of Italy, the accumulation of chalky matter deposited by springs is so great, as to form rocks of much solidity and strength. The water which supplies the baths of San Filippo in Tuscany contains lime and magnesia, and has been known to deposit a solid mass thirty feet thick, in the course of twenty years. Extensive layers of this stony substance are found in the neighbourhood of the springs, reaching a mile and a quarter in length, the third of a mile in breadth, and in some places attaining a thickness of two hundred and fifty feet.

The more loose and porous rock resulting from such springs, generally contains incrusted plants and other substances, and is called *tufa*; the more compact is called *travertin*; and is quarried for building purposes. Many of the most splendid edifices in Rome are built of this stone

The whole western part of Asia Minor is full of petrifying springs, and even the rivers are loaded with mineral substances. Where the ancient city of Hierapolis once stood, there is a remarkable mass of rock, formed

by the tufa, or soft stone, which the springs deposit. This rock appears like an immense frozen cascade, and is, in fact, the petrifaction of falling waters. Dr. Chandler thus describes this Petrified Cascade:—"The view before us was so marvellous, that the description of it, to bear even a faint resemblance, ought to appear romantic. The vast slope which at a distance we had taken for chalk, was now beheld with wonder, it seeming an immense frozen cascade, the surface wavy, as of water at once fixed, or in its headlong course suddenly petrified. Round about us were many high, bare, stony ridges; and close by our tent one with a wide basis, and a slender rill of water, clear, soft, and warm, running in a small channel on the top." The whole region abounds with marks of volcanic action, and the waters have long been celebrated for their extraordinary petrifying powers. It is related that in order to make stone fences round the gardens and vineyards of Hierapolis, it was only necessary to conduct the water into narrow channels, and they soon became filled up with stone. Dr. Chandler found numerous ridges or fences thus formed, and even a road which appeared a wide and high causeway, proved to be a petrifaction.





AIR VOLCANOES.

The principal Volcanoes of the earth pour forth, as it is well known, streams of burning lava, or mineral substances in a molten state; but there are other Volcanoes which send out merely water, mud, or air. Near Quito in South America, where fearful earthquakes have taken place, streams of water, and also of mud called "moya" have been poured from Volcanoes, so as to waste and destroy everything in the neighbourhood. It is a remarkable fact that these mud Volcanoes sometimes send forth vast quantities of small fish, supposed by Humboldt to have lived and multiplied in subterranean cavities of the earth.

Near the small Indian village of Turbaco, twenty miles from Carthagena, in South America, are fifteen or twenty small Volcanoes, rising near each other in a marshy district on the borders of a forest. The simple inhabitants of the village have a tradition that these were formerly firevolcanoes, but that a monk, by sprinkling holy water upon them, put out the fire, and changed them into water-volcanoes. It is not water only, however, but air that is sent out at each eruption, although on climbing to the top, the opening, which is from sixteen to thirty inches in diameter, is seen filled with water, through which the air-bubbles rise.

The surface of the ground is composed of clay, of a dark grey colour, cracked in various places, and quite bare of vegetation. The Volcanoes rise in the form of cones to the height of from nineteen to twenty-five feet; the circumference at the base being, in the largest, from seventy-eight to eighty-five yards. The air rises in these Volcanoes with considerable force, and with a loud noise, causing the water to be projected beyond the crater, or to flow over its brim. Some of the openings by which the air escapes, are situated in the plain, without any rising of the ground. The natives assert that there has been no change in the shape or the number of the cones for twenty years, and that the little cavities are filled with water even in the driest seasons. A stick can easily be pushed into the openings to the depth of six or seven feet, and the dark-coloured clay or mud is exceedingly soft. About five explosions from the several Volcanoes take place every two minutes. The cones have, no doubt, been raised by the condensed air, and a dull sound which is heard fifteen or eighteen seconds before each explosion, proves that the ground beneath is hollow.



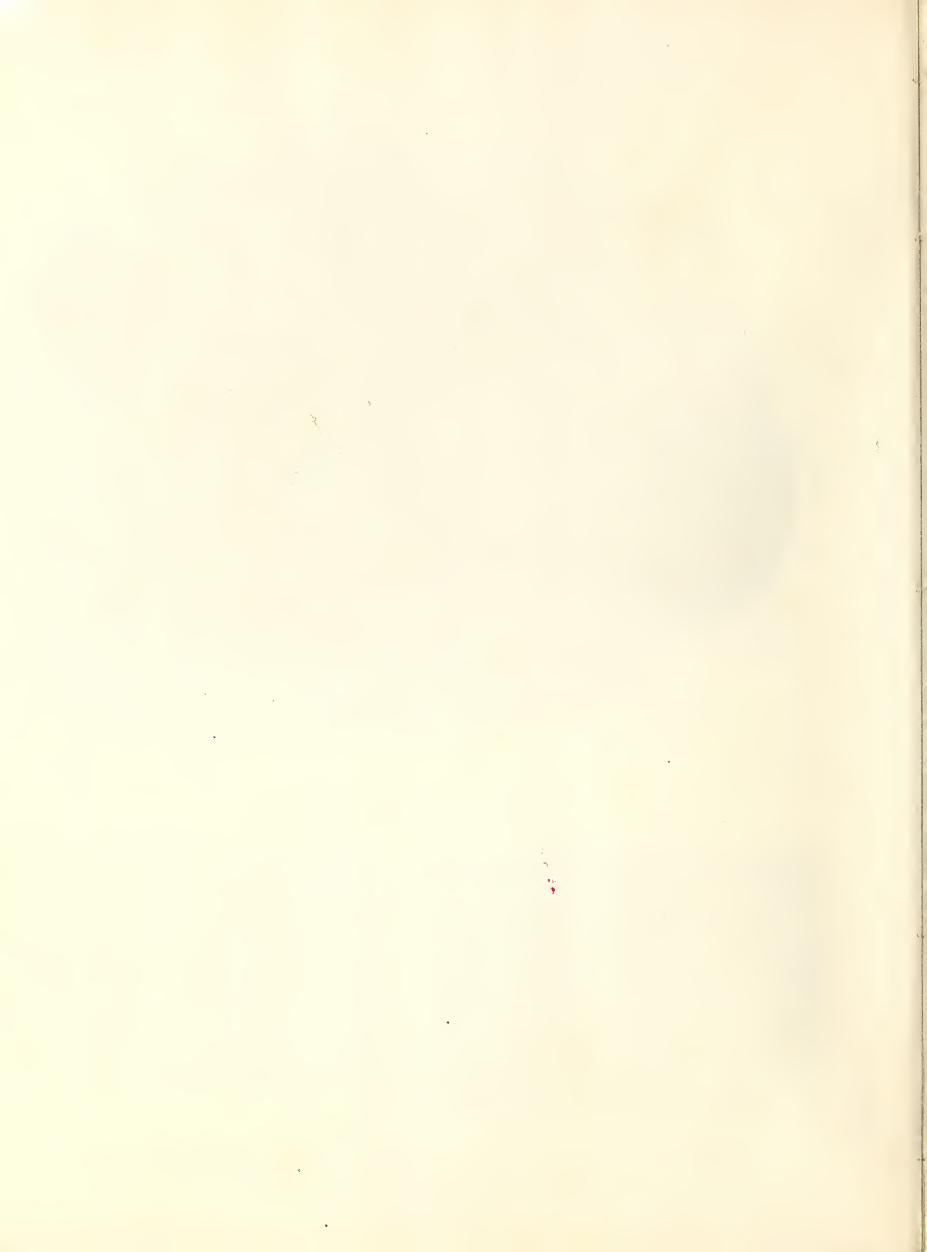


THE DROPPING WELL.

Spring-water, even that which is the most transparent, generally contains certain mineral substances, gathered from the soil through which the water flows. These substances are often so completely dissolved as to leave the water clear and sparkling, while they add to its wholesome qualities, and also render it agreeable to the taste.

It is owing to these mineral substances that many springs have the property of petrifying objects, that is, covering them entirely with a stony crust, which makes them appear as if changed into stone. Such springs are seen in several parts of our own country; but far more strikingly in foreign lands, in the neighbourhood of volcanoes. The Dropping Well at Knaresborough, in Yorkshire, is one of our most noted petrifying springs. It rises at the foot of a limestone rock on the south-west bank of the river Nidd, opposite to the ruins of Knaresborough Castle. After running about twenty yards towards the river, it spreads itself over the top of a cliff, from whence it trickles down in a number of places, dropping very fast, and making a tinkling sound in its fall. The spring is supposed to send forth twenty gallons of water every minute, and while in rapid motion, the fine particles in which it abounds are carried forward, or very slightly deposited; but as it approaches the cliff, or rocky elevation above named, it meets

with a gentle ascent, becomes languid in its pace, and then deposits abundantly on grass, twigs, stones, &c., a petrifying substance which renders them exceedingly beautiful. The cliff is about thirty feet high, forty-five feet long, and from thirty to forty broad, having started from the main bank, upwards of a century ago, leaving a chasm of two or three yards wide. The water is carried over this chasm by an aqueduct; but there is sufficient waste to form beautiful petrifactions in the hollow. Small branches of trees, roots of grass, and other objects, are incrusted with spar, and, together with pillars of the same substance, like stalactites, fringing the banks, form an interesting sight. The top of the cliff is covered with plants, flowers, and shrubs, such as ash, elder, ivy, geranium, wood-anemone, lady's-mantle, cowslips, wild angelica, meadow-sweet, &c. Pieces of moss, bird's nests containing eggs, and a variety of other objects, are exhibited to visitors, as proofs of the petrifying qualities of the water. The weight of the water is twentyfour grains in a pint heavier than that of common water. The top of the cliff projects considerably beyond the bottom, and the water is thus thrown to some distance from the side of the cliff, which is of a concave form.





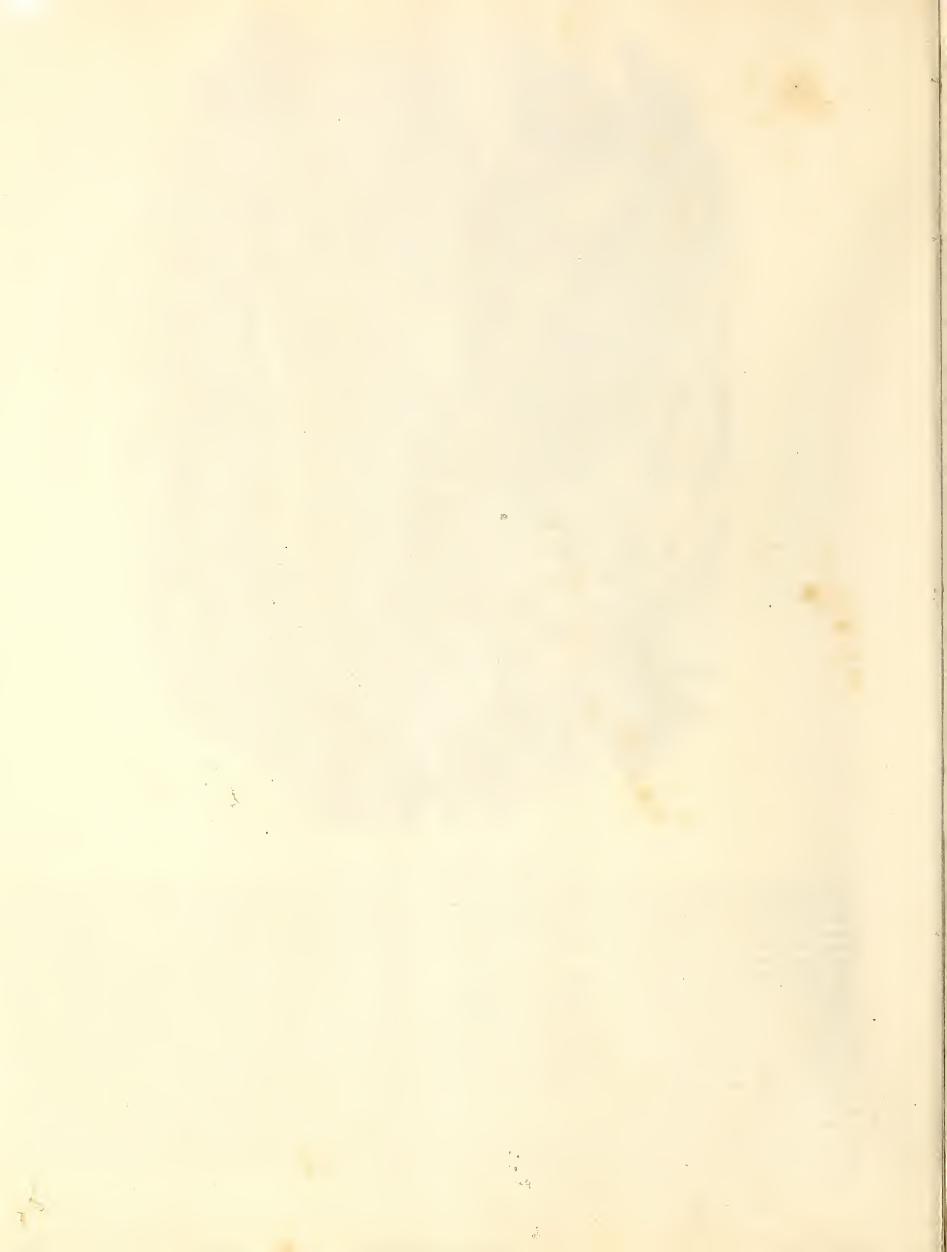
MOUNTAIN PASSES.

The vast barrier formed by an extensive chain of mountains, would shut out the countries on either side from all communication with each other, were it not for certain gaps, or breaks in the line, whereby a passage is obtained over this colossal wall. Such openings are called passes, and are so frequent, that in the Swiss portion of the Alpine Chain alone, there are not less than fifty.

In travelling up these passes, the gradual change in climate, scenery, and produce, which takes place in a day's journey, is very interesting. At first the slopes are covered with corn, ripe perhaps, for the harvest, and the warmth is that of midsummer; further on the crops are green, and scarcely yet in ear; a little higher up the pass the corn gives place to the dark and gloomy pine-forest. Beyond the forest, the vegetation becomes extremely scanty, though even on the edge of the glacier bright flowers peep out during the short summer. But as the top of the pass is gained, vegetation disappears, or is only seen in the dry lichen on the rock. The air becomes intensely cold, and the whole scene is one of wintry desolation.

The above engraving represents a remarkable pass across the Swiss Alps, called the *Gemmi*. The summit of this pass is more than seven thousand feet above the level of the sea; and exhibits the wildest and most dreary aspect, being formed of naked rocks on which not even a lichen is to be seen. From a point very near the summit of the pass a magnifi-

cent mountain view is obtained: Monte Rosa, the second Mountain in Switzerland, and the chain of Mountains which separate the Canton of the Vallais from Piedmont, being immediately in front of the spectator. As the traveller (supposed to be coming from the Canton of Berne) descends into the valley, his path is along the narrow ledge of a precipice of fearful depth, where the rock is all but vertical. Here is formed one of the most extraordinary of the Alpine paths, said to be constructed by the Typolese. It is a shelf or groupe cut in the face of the wall of rock. Tyrolese. It is a shelf or groove, cut in the face of the wall of rock, and varying from three to five feet in width. It descends in a zig-zag manner down the rock, and is scarcely broad enough to allow a mule to pass. The road is protected by a low wall, but it is, nevertheless, a fearful thing to travel along so narrow a shelf, with a wide abyss yawning before you. Over this pass, and along this remarkable road, invalids are constantly carried to the hot springs at Leuk, a small hamlet situated on an elevation greater than that of the highest mountains of Great Britain. Sick and infirm persons are carried on men's shoulders in a sort of litter, and sometimes have their eyes bandaged, that the terrors of the situation may not shock their nerves. Such are some of the wild and terrific features of mountain scenery, among which the traveller, humbled by a sense of danger, and awed by the majesty of nature, can scarcely fail to recognize the wonder-working power of the Divine Hand.





PERFORATED ROCKS.

The powerful action of the sea upon rocks and cliffs is displayed in various ways. When the rocks are of granite or other hard stone, huge blocks are sometimes torn off or removed from their native beds, and thrown to a considerable distance on the land; but when the rocks are of lime-stone or such comparatively soft material, they are often worn and perforated into a variety of remarkable forms. In some places the waves have scooped out caverns of great extent and beauty; in others the limestone cliffs have been broken into columns of various shapes, frequently resembling towers, arches, &c. The wearing action of the waves is chiefly upon a space marked by the rise of the tide, and is greatest at the mean level of the sea. The limestone gives way to this incessant washing in angular fragments, which, after being worn down by the rolling of the surf, are finally deposited in beaches of shingle at an elevation corresponding to the highest rise of the tide.

When one of Captain Franklin's exploring parties were sailing along the shores of the Polar Sea, they found that the cliffs and points of land in Franklin Bay presented many caverns and perforated rocks formed by the action of the waves, and ornamented by graceful slender pillars strongly resembling the windows and crypts of Gothic buildings; these, "exhibited so perfect a similarity to the pure Gothic arch, that had nature made many such displays in the old world there would be but one opinion as to the origin of that style of architecture."

In certain parts of a line of coast, masses of harder rock may occur, and these serve as a sort of rampart against the inroads of the ocean, which are wearing down the rest of the coast. In one of the Shetland Isles, the Atlantic, when provoked by wintry gales, batters against this sort of wall with all the force of real artillery, and by repeated assaults, the waves force an entrance for themselves.



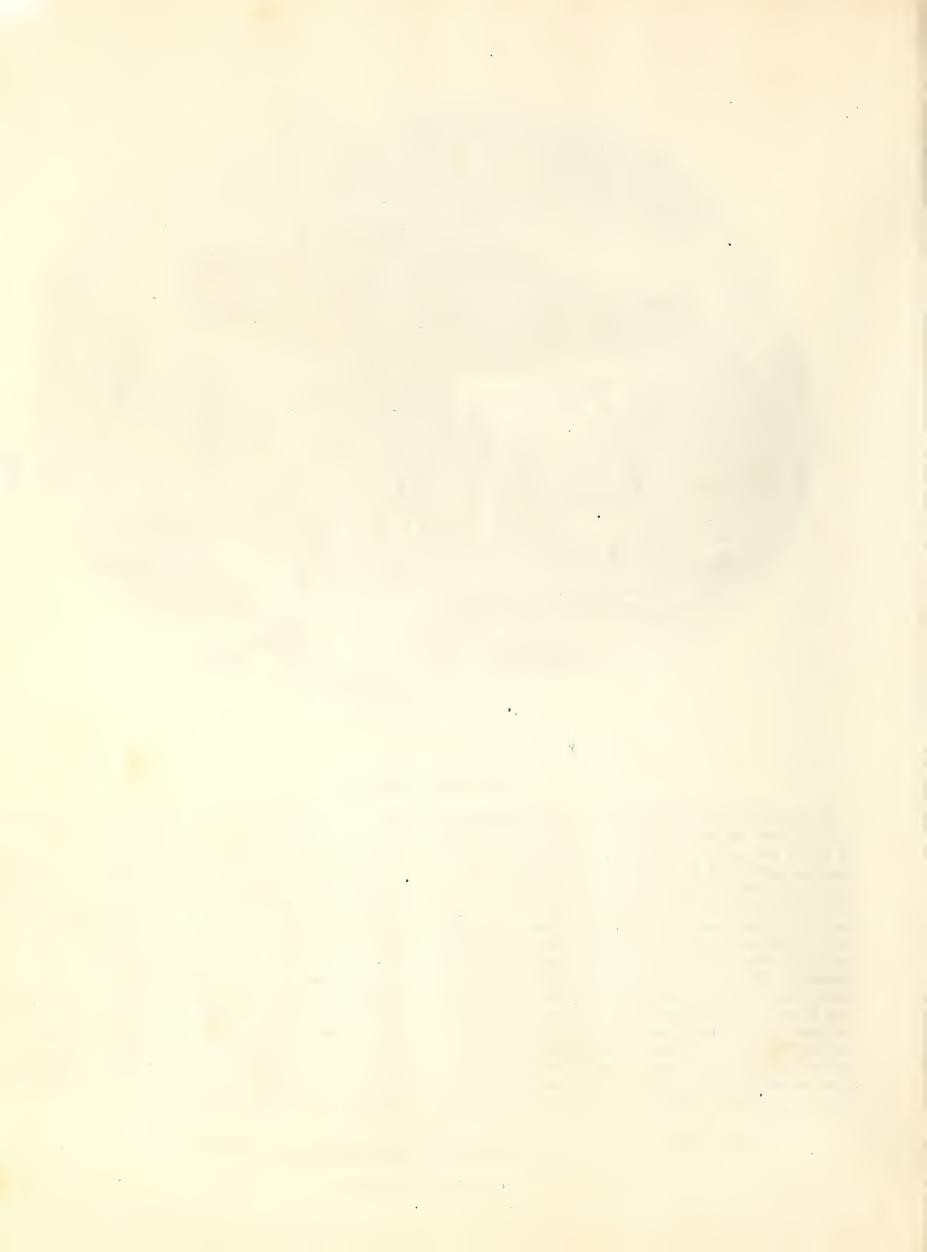


GLACIER TABLES.

On the surface of the Glaciers, or streams of ice which fill the upper valleys of Alpine districts, may frequently be noticed enormous blocks or slabs of stone perched upon stems of ice like huge mushrooms; sometimes entirely, and at other times partly, supported in the air. They are called *Glacier Tables*. One of them, noticed by Mr. Forbes, consisted of a flat block of granite measuring twenty-three feet by seventeen feet, and about three and a half feet in thickness. In the month of June 1842 it was easy to step upon this stone from the general surface of the glacier; but as the season advanced it changed its appearance remarkably. The waste of ice at the surface caused the glacier to sink all round the stone, while the ice immediately beneath it was protected from the sun and rain, as by an umbrella. The stone thus appeared to rise above the level of the glacier, supported on an elegant pedestal of beautifully veined ice. "Each time I visited it," says Mr. Forbes, "it was more difficult of ascent; and at last, on the 6th August, the pillar of ice was thirteen feet high, and the broad stone so delicately poised on the summit of it (which measured but a few feet in any direction), that

it was almost impossible to guess on what it would ultimately fall, although, by the process of the thaw, its fall in the course of the summer was certain." On a still later day, when Mr. Forbes made a sketch of it, "it was," he says, "probably the most beautiful object of the kind to be seen anywhere in Switzerland. The ice of the pedestal presented the beautiful lamellar structure parallel to the length of the glacier. During my absence in the end of August, it slipped from its support; and in the month of September it was beginning to rise upon a new one, whilst the unmelted base of the first was still very visible upon the glacier."

Glacier tables are formed only of such thick blocks of stone as will prevent the heat of the sun from penetrating through. If the slabs are thin, and of a dark colour, a contrary effect is produced; instead of rising, they sink. The heat of the sun is absorbed so quickly that it melts the ice beneath, and the stone soon disappears. A leaf wafted by the wind upon the glacier, a dead insect, or a few grains of black sand, will all sink; while blocks of stone as large as a house, and weighing millions of pounds, are thrust up into the air.





THE BREAKING UP OF ICE-FLOES.

SEA water requires a much greater degree of cold to freeze it than fresh water, and the motion of the waves interferes with the formation of solid ice. In the Arctic Regions, when a strong freezing wind blows over the ocean, the water at the surface forms into a spongy mass, called sludge; this has the effect, to some extent, of stilling the waves, and it forms itself into small plates, which, being rounded by continual rubbing, are called by the sailors pancakes. These cakes, by adhering together, form a solid surface, which, under the influence of the frost, extends in every direction, until at length a field of ice is formed, which often occupies an extent of several hundred square miles.

In these regions the winter lasts seven or eight months, during which the cold is fearfully severe. The greatest danger to the navigator is when the warmth of summer has begun to loosen the icy floor; for the first strong wind, creating a swell in the ocean, breaks up the ice again into fields. These being set afloat, are, by the violence of the winds and currents, broken into *floes*, the size of which can be distinguished from the mast-head of a ship. If the field is broken up into a number of pieces, none of which are more than forty or fifty yards across, the whole is called a *pack*; if the pieces are broad they are called a *patch*; and when long and narrow, a *stream*. When a ship can

sail freely through these masses, the ice is said to be *loose* or *open*, and is called *drift* ice. When it is crumbled into small pieces, it is called *brash* ice.

The numerous fields of ice, once set afloat, are driven about by the violence of winds and currents, and sometimes, approaching in opposite directions, strike against each other with the force of millions of tons, the effect of which is to squeeze up one piece over another, above the common level, and to form what are called *hummocks*. These hummocks have various shapes, and often rise to the height of thirty feet.

The situation of a ship exposed to these moving masses of ice is one of great danger. It may either be crushed between them like a walnut, or, by a more merciful Providence, lifted completely out of the water and placed high and dry upon the ice. The ships engaged in the Northern Whale Fishery are frequently exposed to such dangers as these.

The above is a view of H. M. S. Terror, at the time of the breaking up of the floe into which she had been frozen early in the winter of 1836, in Hudson's Strait, where she continued drifting about until the following summer.





THE FATA MORGANA.

In the Straits of Messina between Sicily and the coast of Italy, a remarkable Phenomenon sometimes occurs, which, from the fairy-like effect produced, is called the Fata Morgana, or the Fairy Morgana.

When the rays of the rising sun form an angle of 45° on the sea of Reggio, and when the bright surface of the water is not disturbed either by the wind or the current, a spectator placed on any high building in the city, with his back to the sun and his face to the sea, observes upon the surface of the water superb palaces with their balconies and windows, lofty towers, herds and flocks grazing in wooded valleys and fertile plains, armies of men on horseback and on foot, with multiplied fragments of buildings, such as columns, pilasters, and arches. These objects pass rapidly in succession along the surface of the sea during the brief period of their appearance. They are, of course, pictures of palaces and buildings actually existing on the shore, and the living objects can only be seen when they happen to form part of the general land-scape.

If, at the time of these appearances, the air is loaded with vapour or dense exhalations, the same objects which are depicted upon the sea will be seen also in the air, from near the surface of the sea to the height of about twenty-five feet. These images, however, are not so distinct as those seen in the sea.

If the air be slightly hazy, as when dew is falling, the objects will be

seen only on the surface of the sea, but they all appear fringed with red, yellow, and blue light, as if they were seen through a prism.

When this phenomenon, which does not often occur, is to be seen, the

people of Reggio hail it with exultation and joy, running down to the sea-side, clapping their hands and exclaiming, "Morgana! Morgana! Fata Morgana!"

Similar Phenomena are not unknown in our own country. The following instance, which lately occurred in the neighbourhood of the Land's End, in Cornwall, has been thus stated to the writer by the gentleman who witnessed it. "There appeared out at sea, and where there was no land, an island, with roads leading from the shore, hills, houses, a church, and smoke, apparently coming from the chimneys of some cottages. The astonished guide at first pronounced the island to be one of the Scilly Islands, till he remembered that those islands lay in a different direction. The vision, however, gradually faded away; it was probably the picture of the shore on which the spectators were standing."

There is considerable difficulty in accounting for these appearances. The images formed in the air are produced by the unequal refraction or bending of the rays of light; and it has been supposed that the pictures seen in the sea may be the aerial images reflected from its surface, or from a stratum of dense vapour; or that they may be the direct reflections from the objects themselves.





THE IGNIS-FATUUS, OR WILL-O'-THE-WISP.

In marshy and boggy places a light is sometimes seen to hover over the ground by night, appearing from a distance like a taper gleaming from some cottage window. The light is not stationary, and should any incautious traveller approach it, it moves before him, and thus leads him into bogs and marshes where he is in danger of perishing.

This appearance is called *Ignis-fatuus*, or *vain*, or *wild fire*. It is also called *Will-o'-the-Wisp* and *Jack-o'-Lantern*, by the country people, these being the names of a malignant spirit to whom the appearance was formerly attributed. Of late years the cause seems to have been well ascertained to be the lighting up of an inflammable gas produced by decaying animal and vegetable matter in bogs, marshes, and stagnant pools. It is found that when damp soils are drained and cultivated the Will-o'-the-Wisp disappears. Such has been the case with the extensive bogs and marshes which formerly occupied a large portion of the counties of Northampton, Huntingdon, Cambridge, Lincoln, Norfolk, and Suffolk.

In crossing the wild moors near the place where the counties of Northumberland and Cumberland join, the Will-o'-the-Wisp has often been seen. Two gentlemen were once riding over these moors when they were surprised about ten o'clock at night, by the sudden appearance of a light within fifteen yards of the road side. It was about the size of the hand, of an oval well-defined shape, and was more like a bright white cloud than a flame. It was seen in a very wet place where peat-moss had been dug out, leaving what are called "peat-pots," which soon fill with water and nourish various plants, which in their turn are changed into peat. The light was about three feet from the ground,

and hovered for a time over the peat-pots, then moved to the distance of about fifty yards, and suddenly went out.

Major Blesson, of Berlin, a few years ago, made some experiments on this subject in a marshy valley in the forest of Gubitz. Bubbles of gas were observed to risc from the water of the marsh in the day time, and by night blue flames were playing over its surface. On visiting the spot by night the flames retired as Major Blesson advanced, the motion of the air driving the burning gas before him. On remaining perfectly still, the flames returned, and he attempted to light a piece of paper by them; but the current of air produced by his breath kept the flames at too great a distance. On turning away his head, however, and holding up a screen of cloth, he was able to set fire to a narrow strip of paper. He also succeeded in putting out the flame by driving it before him to a part of the ground where no gas was produced, then applying a flame to the surface whence the gas bubbles issued, a kind of explosion was heard on the surface of the marsh; a red light was seen, which diminished to a blue flame about three feet high. This continued to burn with the unsteady motion observed in the Will-o'-the-Wisp. As the morning approached all the flames became pale, and seemed to approach nearer and nearer to the earth, till they at last faded from the sight. Major Blesson thinks that when once the thin stream of inflammable air is set on fire, it continues to burn by day as well as by night, but the light is so pale that it cannot be seen by day.

The Will-o'-the-Wisp has been accounted for in various ways, but none of them appear to be so satisfactory as the above.





AVALANCHES.

In all countries where the mountains rise to a great height, and are covered with snow, the fall of avalanches occurs more or less frequently. These terrible and destructive phenomena consist of immense masses of ice or snow which suddenly descend from the upper parts of mountains into the valleys beneath with amazing velocity, and with such resistless force that every thing is swept away before them, even whole forests and villages when such occur in their course.

There are several different kinds of avalanches to which distinct names are given by the inhabitants of the Alps. Those most commonly seen by tourists are *ice avalanches*, or portions of glaciers giving way under the influence of the summer's sun. When seen from a distance, these masses of ice, breaking into smaller fragments against the rocks as they fall, resemble rushing cataracts, and are accompanied by a similar thundering noise. Such avalanches mostly fall in uninhabited districts, and are seldom fatal in their effects: they occur only during summer, but are very frequent at that season.

Earlier in the year, avalanches of a more dangerous character fall with considerable regularity, sliding down habitual channels which become perfectly smooth from the friction which they thus undergo from time to time. These regular avalanches are eagerly expected by the peasants as the sure tokens of the commencement of Spring. But circumstances which cannot be foreseen will sometimes divert these avalanches from their usual course, or cause them to fall unexpectedly. They consist of masses of compact snow and ice, which are yet clammy and adhesive, so that the traveller may be crushed or suffocated in a moment. The masses are sometimes of enormous extent, covering

meadows and forests with a thick layer of snow, which the heat of two or three summers is scarcely sufficient to melt. The instantaneous fall of these snowy avalanches may overwhelm a village in the night without the inhabitants being aware of the calamity which has befallen them. Such was the case in 1749, when the village of Bueras, in the Canton of the Grisons, was buried, and at the same time removed from its site. The inhabitants, on awaking in the morning, could not imagine why daylight did not appear. One hundred of these unfortunate villagers were dug out of the snow, sixty of whom were still alive, the hollows in the snow having contained air enough to support life in the more robust among them.

Another kind of avalanche, and the most destructive of all, is the drift avalanche, which takes place in winter after a very heavy fall of snow. Violent gusts of wind detach large masses of snow from the heights where they have accumulated: these, falling on the lower declivities, force off other masses, so that a volume of loose snow of immense extent is accumulated and cast with astonishing force into the valleys beneath. These avalanches are greatly dreaded, not more for their own violence, than for that of a rush of air which accompanies them, and is occasioned by them, and which has been known to carry destruction to a considerable distance on either side of the falling masses. This rush of air is powerful enough to overturn trees and houses, and even to split rocks asunder. These drift avalanches have been known to descend, with amazing rapidity, a distance of at least ten miles. Such are the sublime displays of power, which impress with awe and reverence the mind of the mountain traveller.





TORRENTS OF MUD.

In the higher recesses of mountain regions slow and silent processes are in operation, sometimes for many years together, which not only produce changes in the form and character of mountains, but at length issue in the most unexpected and appalling effects. These processes may be, first, the gradual, but irresistible, motion of those icy streams, called glaciers; or, secondly, the penetrating of water from melting ice and snow through fissures or openings in rocks, until, by alternate freezing and thawing, it separates portions of their substance; or, thirdly, the softening of immense beds of clay, on which many rocks are found to rest. From such causes as these, arise the land-slips, inundations, avalanches, and torrents, to which the Swiss valleys and villages are liable. It was owing to the gradual softening of extensive beds of clay, that a most destructive land-slip took place in 1806 from the Rossberg, a mountain in Switzerland nearly five thousand feet high. Suddenly, and within the space of five minutes, a portion of this mountain, a league in length, one thousand feet broad, and one hundred feet thick was precipitated, together with a torrent of mud, into the valley beneath, and destroyed three villages, more than three hundred houses, stables and huts, and about four hundred and fifty human beings, besides whole herds of cattle.

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The Val de Bagnes, near Martigny, has been more than once devastated by means of masses of ice and snow from the glacier of Getroz, completely blocking up the mountain torrent which feeds the river Drause. Behind this barrier the waters accumulated in a fearful manner in 1818, forming a lake which was estimated to contain eight hundred millions of cubic feet of water. Notwithstanding the most persevering and ingenious efforts to drain this lake by means of a tunnel cut through the ice, the waters burst through the barrier with a tremendous crash, carrying away rocks, forests, bridges, houses and cultivated lands.

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Between Martigny and the lake of Geneva, in the month of August 1835, a torrent of mud descended from the summit of the Dent de Midi, into the Vallais near Evionaz. The following account of this catastrophe has been communicated to us by a gentleman who visited the spot in August 1838, and who found the whole Vallais presenting a most desolate appearance, "being covered with crumbled fragments of rotten slaty rock," or with huge masses of

the same substance, together with trees and bushes, brought down by the great "débâcle," or "écoulement," (or flow,) as this torrent is called.

"It would appear, from the accounts of the people in the neighbour-hood, that one day in August, 1835, a crashing noise was heard in the mountain, and shortly afterwards the écoulement was seen to issue from the ravine, (shown in the above cut) overthrowing and carrying along with it trees and everything else that it met in its course. The advance of the slimy torrent, although not rapid, was irresistible, and in about a couple of hours it had covered, in a fan-like form, the whole slope down to the Rhone. No lives were lost; but the peasants who lived in a few scattered cottages in the ravine, and in the vicinity of its mouth, were scared from their dwellings, and suffered some considerable loss of property. I was assured that no water was seen:—It was like a deluge of bluish grey mud, intermixed with slaty rocks, and exhibiting much the same appearance to the eye as it does at present. It continued to flow, but gently, for two or three days, and then stopped. The next year, however, and at the same season, a similar écoulement, though of a less fearful nature, took place. The phenomenon is generally supposed to have arisen from the rotten state of the rock, under the glaciers of the recesses of the Dent de Midi."

It is also conjectured to have been caused by a glacier bursting,

It is also conjectured to have been caused by a glacier bursting, and sweeping along with it the débris of the Moraine, converted into mud. As it moved down from an immense height, the momentum it acquired carried it forward at last with irresistible violence, sweeping away blocks of stone many tons in weight, which floated like corks upon the surface. It covered the high road for a length of about nine hundred feet, and overwhelmed many fields, orchards, and some few houses. Such phenomena are by no means new in that neighbourhood. It appears, from the accounts of the people in the neighbourhood, that "some very long time ago, the Rhone, in that part of its course, flowed much more nearly through the centre of the Vallais, and that a town or village, named Penassez, stood upon its bank, but that a débâcle from this same ravine overwhelmed Penassez, and drove the Rhone eastward, to the channel which it now occupies, at the very foot of the opposite mountain, the Dent de Morcles, which bounds the Vallais on that side."





WHIRLPOOLS.

THE waters of a river, or of the sea, are in some places obstructed by banks, rocks, or islands, or by winds and currents, and thus acquire a circular or spiral motion, forming what is called a *whirlpool*.

The above engraving represents one of the most celebrated whirlpools, that of Charybdis, in the Straits of Messina, between Italy and Sicily. The water is agitated in several different places at the same time within circular spaces, none of which, when the wind is moderate, exceed one hundred feet across. This agitation is produced by the wind acting in a sloping direction upon the rapid current which sets in from the north during six hours, and from the south during the next six hours, and so on alternately; the changes taking place with the rising and setting of the moon. During a light wind a boat can be rowed over the spot without danger, though it will be much tossed by the waves; but when the wind is high, the swelling of the waves is more violent and extensive, so that small vessels driven within the limits of the whirlpool may be sunk by the waves breaking over them, and large ones may be driven on the Italian shore, and wrecked on the rock of Scylla. Thus it is often said of persons in difficult and dangerous circumstances, that they are between Scylla and Charybdis. The dashing of the waves on the hollow rocks about Cape Peloro produces a noise which is said to be like that of the barking of dogs, whence probably arose the fable that a monster surrounded by ferocious dogs devoured the mariners who might be wrecked on this coast.

The Maelstrom on the coast of Norway, between the islands of Mosker and Warae, is a whirlpool of a similar kind, the dangers of which seem to have been much exaggerated. The tide there forms a current which runs with violence alternately from north to south and from south to north, and when this is met by a strong wind, a great agitation of the waves and a whirlpool is formed, the roaring of which

is heard at the distance of many miles. At such a time vessels keep at a distance, in order to avoid being drawn into the current. Whales, seals, and other fish, when caught within its eddies, are dashed on the shores by the violence with which the waters rush through the channel. In moderate weather, at high and at low water, ships pass through the strait without danger.

Among the Orkney Islands several small whirlpools, capable of whirling round a boat, are to be seen. But it is said that a log of wood, or a bundle of straw, thrown into the water, is sufficient to stop the revolving motion of many of them, after which boats can pass over in safety. The whirlpool of Coryvrechan in the narrow channel between Scarba and Jura in the Western Islands, is caused by a conical rock rising abruptly from the bottom, where the depth is six hundred feet, and reaching to within 90 feet of the surface. This obstruction in a winding rocky channel produces a succession of eddies, and when the flood tide sets in, with a fresh breeze in the opposite direction, the eddying waters rise in short heavy waves, which are very dangerous to boats, and even to decked vessels.

When the rotatory movement is rapid the centre of the whirl-

When the rotatory movement is rapid the centre of the whirlpool is the most depressed portion, and objects drawn within it are sunk at that point.

Small whirlpools or eddies are not uncommon in rivers where the banks are very winding, or the bed much contracted. They are also formed about the piers of a bridge when the river is so much contracted as to cause its surface above the bridge to be much higher than the surface below. When the bed is of unequal depth vertical whirlpools are occasioned by the reflection of the water from the ascending slopes.

Whirlpools sometimes do great damage in rivers by loosening the piles driven for the formation of dams; and by lifting up earth and stones, and thus undermining the piers.





SAND STORMS.

In the hot sandy deserts of Arabia, Africa, and other places, the wind from particular quarters is rendered hot and dry in passing over the heated surface of the sandy waste; and when violent, it raises the sand in clouds sufficient to darken the air, or forms it into columns which move about like water-spouts in the desert. Such a storm is called *Simoom* in Arabia, and *Sirocco* in Africa. The Arabs are said to perceive its approach by a sulphurous smell, and an unusual redness in the quarter whence it comes. The sky, usually serene and cloudless, becomes overcast; the whole atmosphere appears to be on fire; the dust and sand are carried high into the air, which assumes a reddish, or bluish, or yellowish tint, according to the nature and colour of the ground from which the dust arises. The yellow, however, always more or less prevails. In a stormy Simoom, witnessed by Burckhardt, he says that a pretty correct idea of the appearance of the air may be formed, in looking through a glass of a light yellow colour. During these storms the heat is very oppressive. Burckhardt has seen the thermometer stand at 121° in the shade, and such is the dryness of the air, that water sprinkled on the ground is dried up in a few minutes. The most disagreeable effect of this hot air on man is, that it stops perspiration, dries up the palate, and produces great restlessness.

When a Sand-storm overtakes travellers in the open desert, they sometimes lie flat on the ground until it passes over, as these storms always move at a certain height in the atmosphere. The camels and other animals also bow down their heads and bury their nostrils in the sand. The danger is said to be greatest when the wind blows in squalls, which raise up so much sand that it is impossible to see to the distance of a few yards. "In these cases, the traveller generally lies down on the lee side of his camel; but as the desert is soon blown up to the level of its

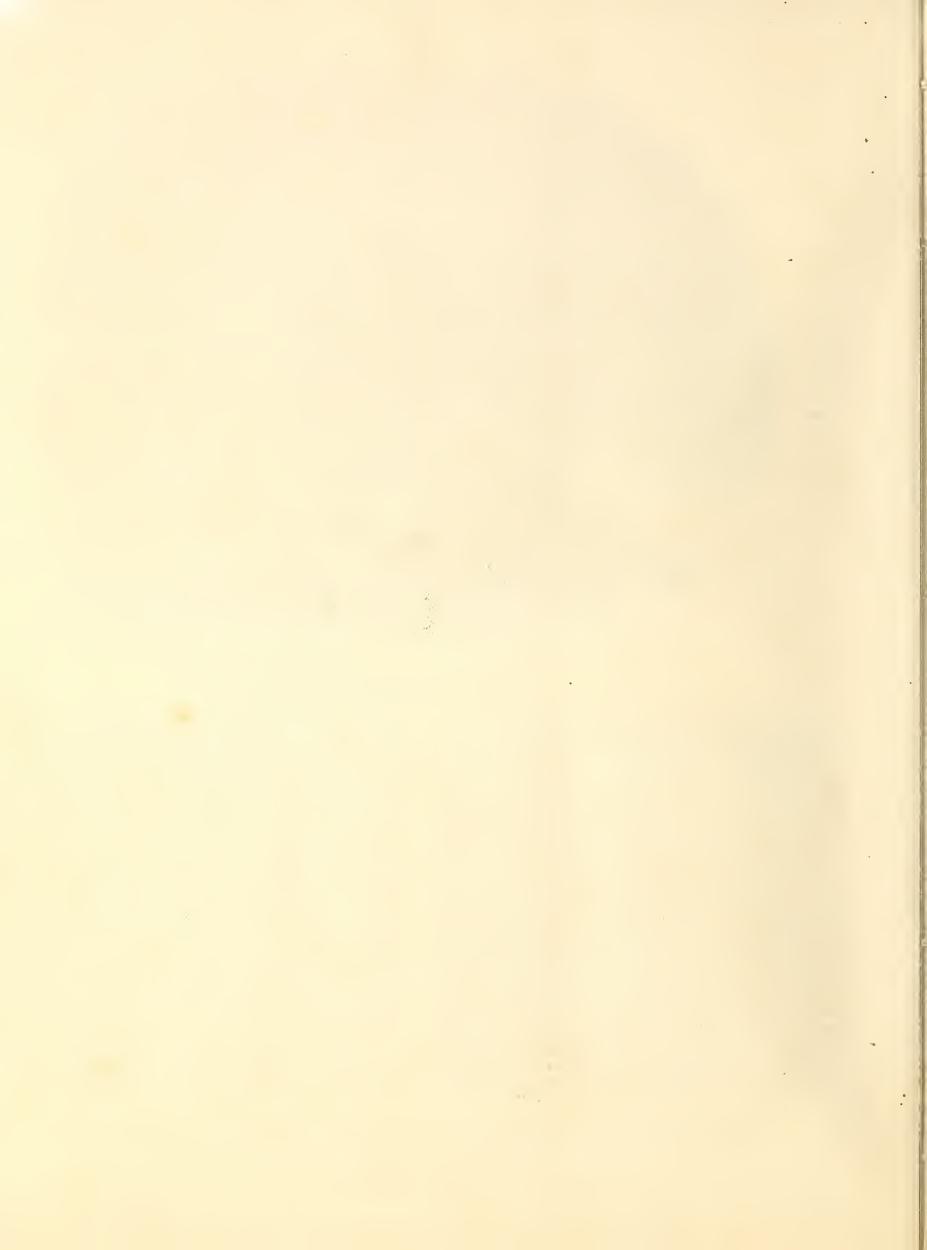
body, both are obliged frequently to rise and replace themselves in a new position, in order to avoid being entirely covered. In many instances, however, from weariness, faintness, or sleepiness, occasioned by the great heat, and often from a feeling of despair, both men and animals remain on the ground, and in twenty minutes they are buried under a load of sand." The Simoom usually lasts three days, but if it exceed that time it becomes insupportable. In its less violent degree, it will blow for hours with little force although with oppressive heat.

Mr. Buckingham describes one of these Sand-storms as commencing with a dull red mist, not unlike the sun-rise skies of northern climates; and soon afterwards forming large columns of sand and dust which were whirled up into the air and carried along in a body over the plain with a slow and stately motion. "One of these, apparently from 80 to 100 feet in diameter, was certainly of sufficient force by its constant whirling motion to throw both men and animals off their legs, so that if crossing a crowded caravan, and broken by the interruption of its course, the danger of suffocation to those buried beneath its fall would be very great.'

Such are the dangers of the desert, which remind us of those of the Swiss Alps, where the wind sometimes raises up the snow, and fills the air with it like a mist which the eye cannot penetrate. Travellers may be suffocated by these tourmentes, as they are called, as effectually as by

the Sand-storms.

Pillars of snow are also sometimes raised by the wind. Captain Lyon, while wintering in the Arctic Regions, noticed one moving over the ice. "The circumference of the column of loose snow which was drawn into the vortex of the whirlwind was at first very inconsiderable, but increasing rapidly, it assumed the appearance of a small water-spout.





VOLCANOES.

Those places on the earth's surface where subterranean fires have formed openings are called *volcanoes*. A volcano is a sort of pipe, or chimney, which occasionally pours forth streams of melted rocks or *lava*, showers of ashes and sand, torrents of water and mud, and jets of steam and gas. The general form of a volcano is that of a regular cone, at or near the top of which is a circular pit, or cavity, in the form of a funnel, called the *crater*. The conical form is occasioned by the substances thrown out of the crater lodging on all sides round about the opening.

Volcanoes are very numerous, and are found in various situations; some in plains at a small elevation above the level of the sea, others in the midst of, or near to mountain ranges. The most remarkable volcanoes in Europe are, Etna in Sicily, Vesuvius in Italy, and Hekla in Iceland. Of these the eruptions have been frequent, about fifty being recorded of Etna; while within little more than a century, Vesuvius has had eighteen eruptions. There is no record of Vesuvius as an active volcano till the year A. D. 70, up to which time the ancient crater presented a slight circular hollow, the sides of which were overgrown with wild vines, and the outside of the cone was well cultivated. In that year, however, there was a dreadful eruption, which destroyed three towns, Stabiæ, Herculaneum, and Pompeii. Etna, in 1699, poured out from a long rent in its flank a stream of lava, which, in its course to the sea, destroyed fourteen towns and villages, some of which contained three or four thousand inhabitants.

The volcanoes of America are very numerous, and of great size. Several of the loftiest mountains of the Andes are active volcanoes, the eruptions of which produce terrible earthquakes. Cotopaxi, which rises to an elevation of sixteen thousand eight hundred feet above the sea, is an active volcano. One of the most remarkable is the volcano of Jorullo, represented in the above engraving. It is situated to the west of the city of Mexico. The formation of this volcano does not date farther back than 1759. Up to that time a fertile, well-cultivated plain existed on the spot. Iu June 1759 thundering noises where heard underground, accompanied by frequent shocks of earthquakes, which continued during fifty or sixty days. In September the inhabitants hoped that these fearful phenomena were at an end; but on the 29th of that month they were renewed, and a space of about four square miles rose up, like an enormous bladder, to the height of above five hundred feet. Those who gained the neighbouring mountains saw flames shoot up from a surface of a square league in extent, and huge masses of ignited rock hurled into the air through a dense cloud of ashes. The surface of the ground appeared like a troubled ocean. The waters of two streams poured into the burning chasm, and this seemed to increase the fury of the flames. Thousands of small burning cones, of from six to eight feet high, issued from the surface; and in the midst of these hornitos, or ovens, as they are

called, six vast mountain masses arose to a height varying from three hundred to sixteen hundred and ninety feet above the former plain. The highest of these is the volcano of Jorullo, which is constantly burning, and has thrown out a vast quantity of ashes and lava, mingled with fragments of rocks. The ashes of this eruption were scattered to a distance of one hundred and sixty miles. The eruptions of the Jorullo continued till February 1760 without ceasing, but they have since become less frequent.

An eruption of Vesuvius begins with a violent crash, if not with an earthquake, and the crater is broken open by the invisible vapours within. A loud, hollow, rumbling noise is heard, interrupted by violent explosions. The white smoke which previously issued from the cone darkens in colour, and at length becomes quite black, rising higher and higher above the summit. With this column is thrown up an immense quantity of solid matter, called scoria, sand, and ashes; large masses of rock are also thrown up with a crashing noise, many of which, bursting asunder, produce a shower of splendid sparks. The appearance of this column by night is extremely grand and awful; the light issuing from the lake of burning lava in the crater illuminates the column, and the masses of glowing rock rising and sinking within it are more distinctly seen.

After a time the larger pieces of rock cease to be thrown out, but the quantity of ashes is much increased: the column of smoke rises higher and higher, and the upper part expanding on all sides, gives it the appearance of a kind of pine-tree common in Italy; on which account the column of smoke towards the close of the eruption is called the pine. "This beautiful phenomenon is an object of admiration even in the day-time, but in the dark night it presents one of the most impressive scenes of beauty which nature can afford. The column of smoke is converted into a magnificent column of fire by the reflection of the light from the crater, and its interior is literally dotted by numberless shining points of great splendour, which are the many millions of glowing grains of sand and ashes rising and falling continually. In the column, but still more frequently in the cloud above it, flashes of forked lightning are seen every moment in all directions, and are accompanied by thunder. After this has lasted for some hours, the cloud imperceptibly vanishes and the column of ashes gradually disappears. The eruption is at an end."

The force with which volcanoes shoot out stones, sand, &c. is enormous. The dust of the volcano of St. Vincent was carried more than two hundred miles to the east of that island. It is stated that Vesuvius has projected large stones three thousand six hundred feet above its summit, and Cotopaxi has been known to hurl a rock calculated to contain two hundred tons to a distance of rather more than ten English miles.

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